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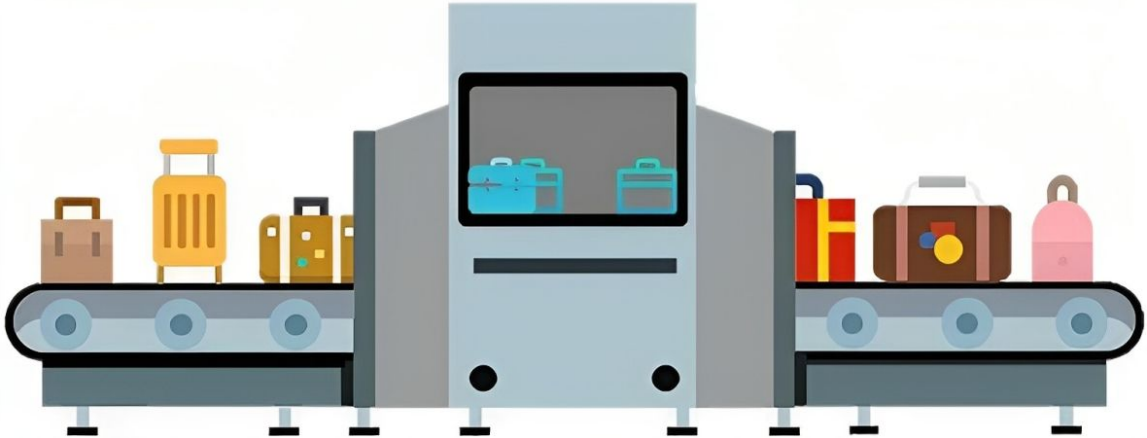
TUWAIQ ACADEMY

SDAIA
الهيئة السعودية للبيانات والذكاء الاصطناعي
Saudi Data & AI Authority

Basirah — Automated Baggage Scanning System

Enhancing Security and Efficiency



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Problem Statement

The existing baggage screening processes rely heavily on manual inspection and are facing numerous challenges in ensuring the security, efficiency, and convenience

01

Security Threats

Proning to human errors, leading to potential security threats going undetected

02

Inefficiency

Time-consuming and labor-intensive, causing long queues, delays, and customer inconvenience.

03

Cost Burden

Labor-intensive baggage screening operations result in high staffing costs

04

Lack of Data Collection

limits the ability to analyze trends in baggage content and identify potential security threats

05

Inconsistency

Different human screeners may interpret X-ray images differently

Facts

8.2B passengers by 2037

According to the ernational Air Transport Association (IATA), global air passenger numbers are expected to reach 8.2 billion by 2037

2M passengers daily

The U.S. Transportation Security Administration (TSA) reports that it screens more than 2 million passengers and their luggage daily.

95% human error

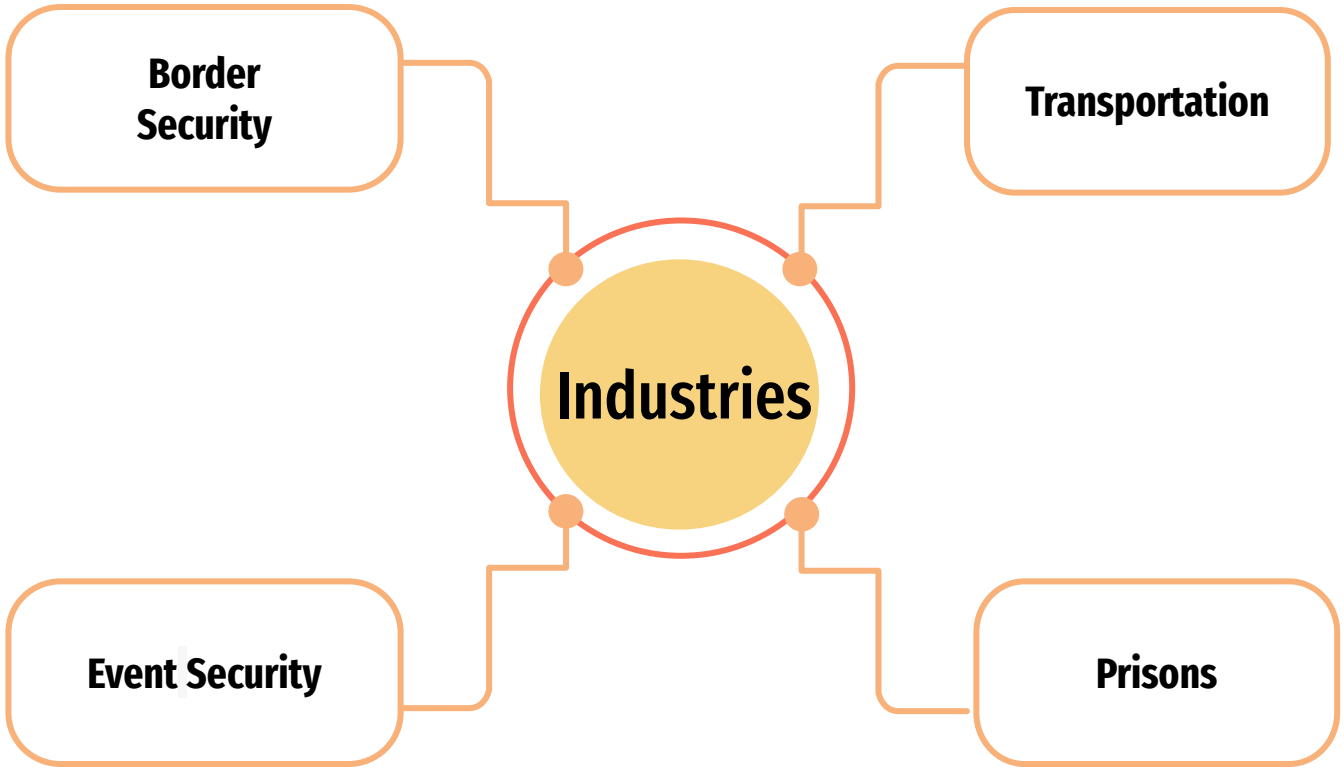
The TSA reports that human operators of baggage screening systems can miss up to 95% of potential threats.

Basirah - Proposed Solution

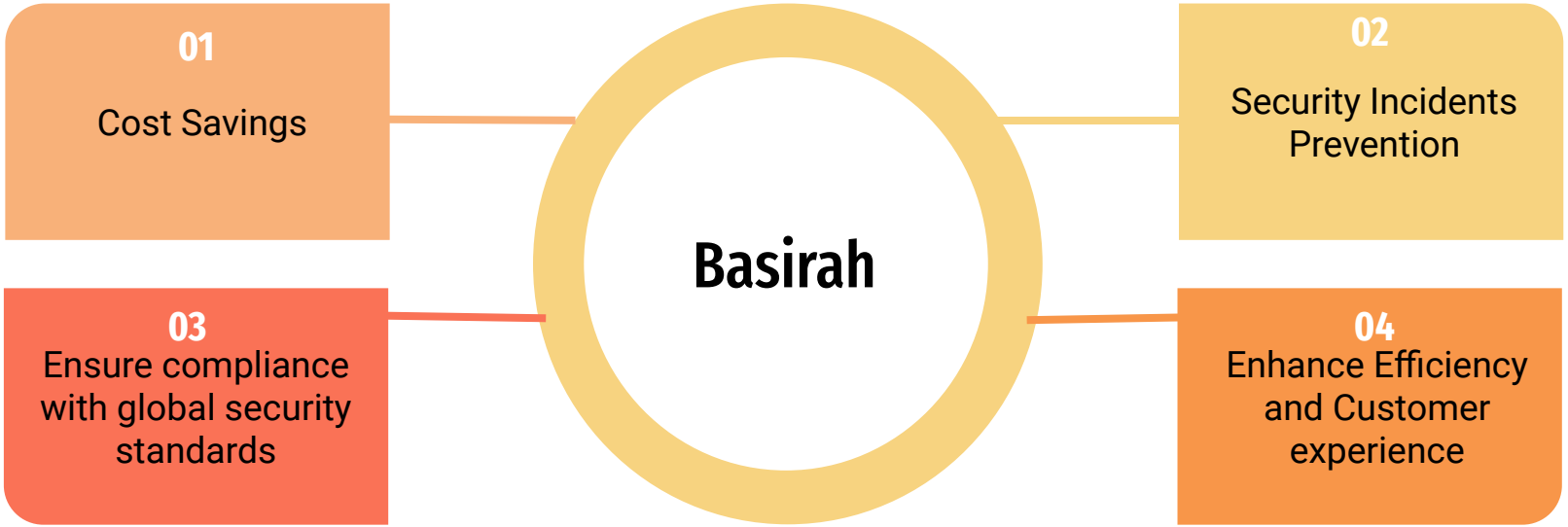
Basirah is an advanced baggage scanning system that employs computer vision technology to detect and raise alarms for prohibited items in baggage.

It enhances security by automating the baggage screening process and improving the efficiency and accuracy of threat detection.

Basirah offers reliable and robust baggage screening solutions for various industries


Border Security
Transportation
Industries
Event Security
Prisons

Basirah - Benefits



Basirah - Workflow

Start

Baggage Submission

- Passengers submit their baggage at the check-in counter as usual.
- Baggage is then routed through the automated Basirah scanning system.

Computer Vision Analysis

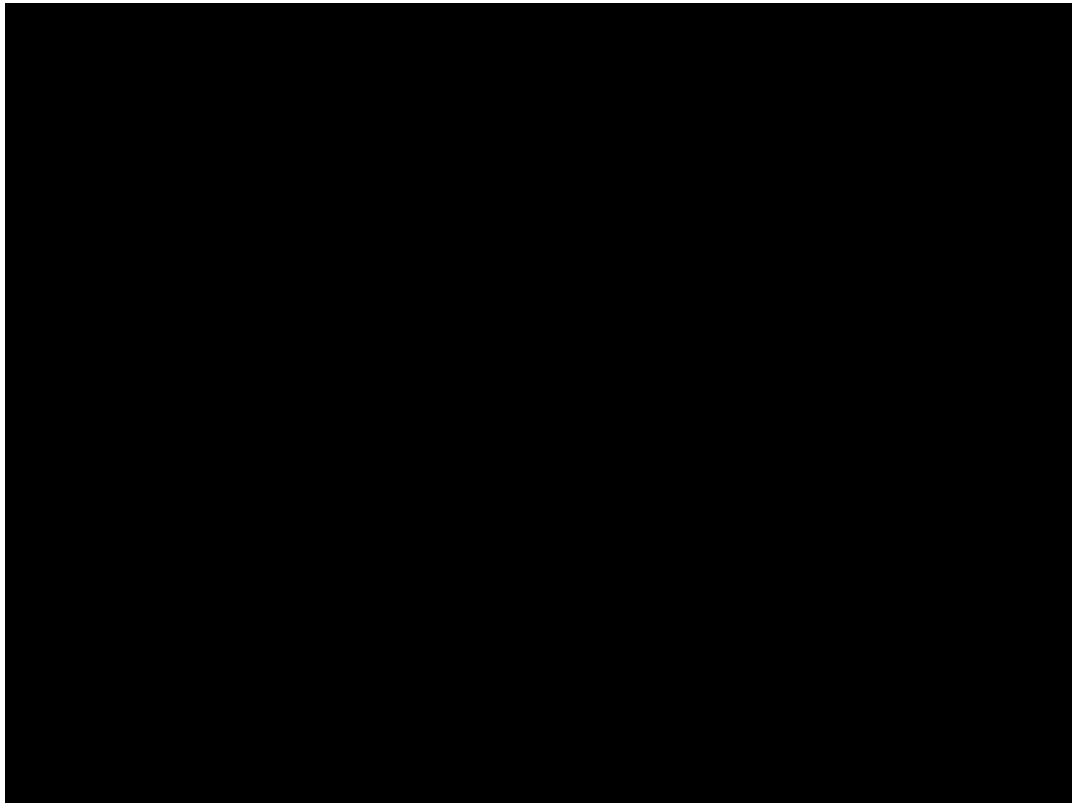
- Basirah captures X-ray images of the baggage scanners.
- The computer vision algorithms analyze the images to identify potential threats.

Threat Detection and Alarm

- If a prohibited item is detected, Basirah raises an alarm and alerts the security personnel.
- The alarm triggers further inspection and necessary actions to ensure passenger safety.

End

Demo



https://clipchamp.com/watch/rTDcc7kdjVP

Methodology

1. Dataset Preparation
2. Model development
3. Model Evaluation
4. Deployment

Dataset Preparation

x ray airport baggage scanner images

01

8830 images

Classes: 5
- Gun
- Knife
- Pliers
- Scissors
- Wrench

+

02

1721 images

Classes: 7
- Handcuffs
- knife
- lighter
- power bank
- pressure
- scissors
- zippo oil

+

03

4699 images

Classes: 8
- USB Flash Disk
- battery
- knife
- lighter
- plastic Bottle
- pressure
- scissors
- seal

=

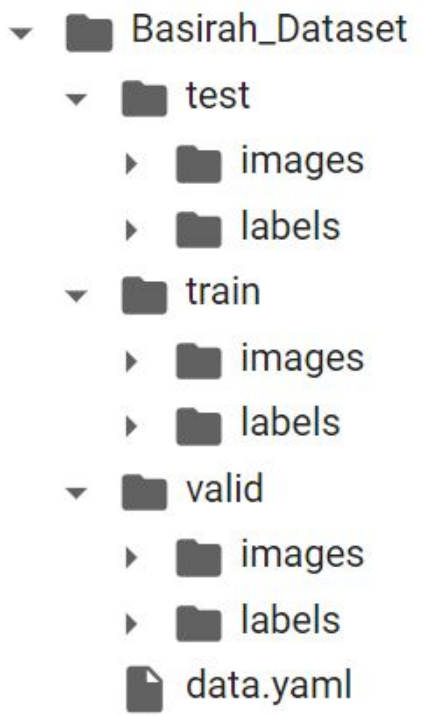
=

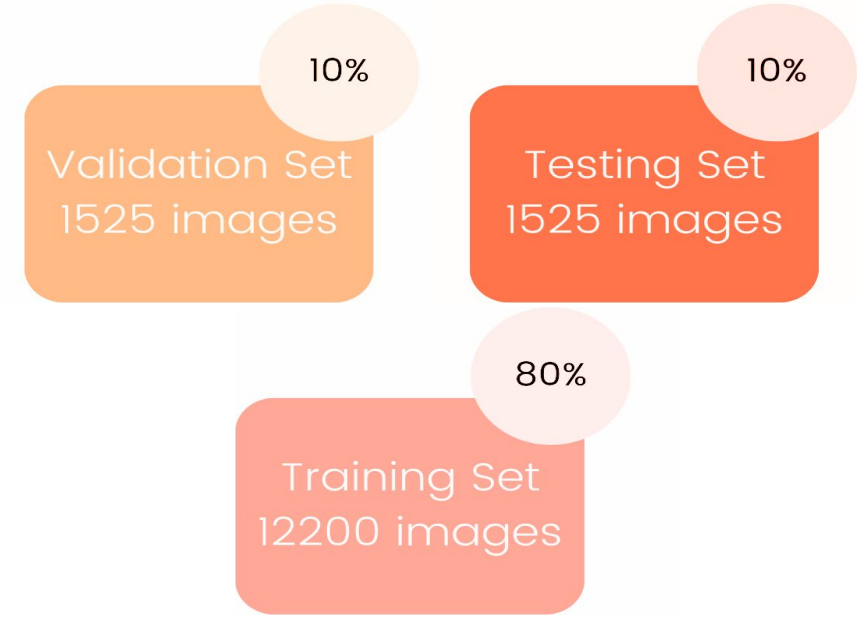
Our Dataset

15250 images

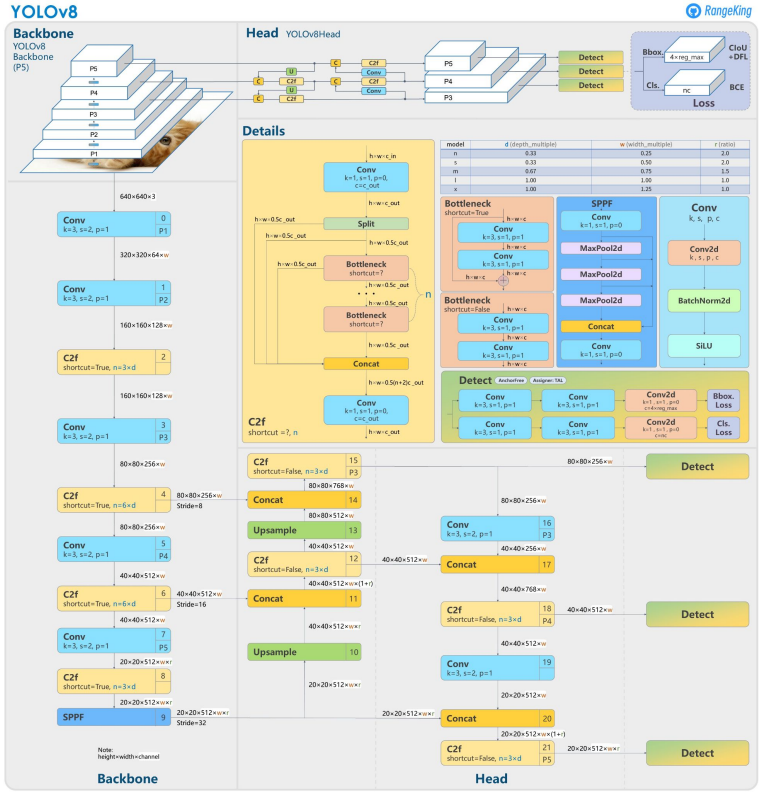
Classes: 14
- USB Flash Disk
- battery
- knife
- lighter
- plastic Bottle
- pressure
- scissors
- seal
- handcuffs
- powerbank
- zippo oil
- Gun
- Pliers
- Wrench

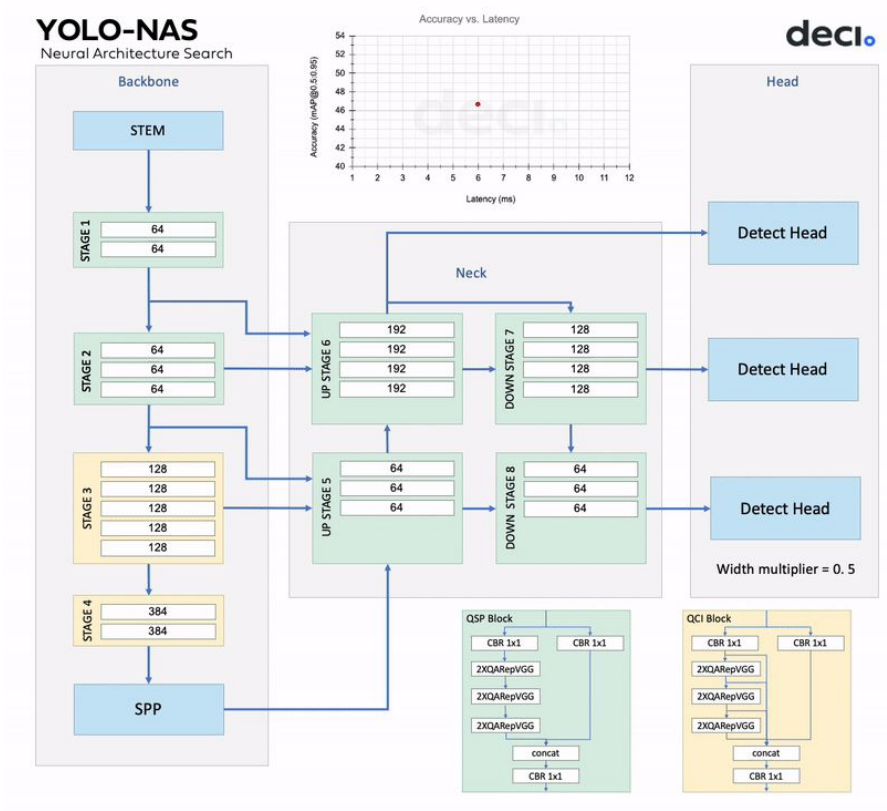
Dataset Split





Model development

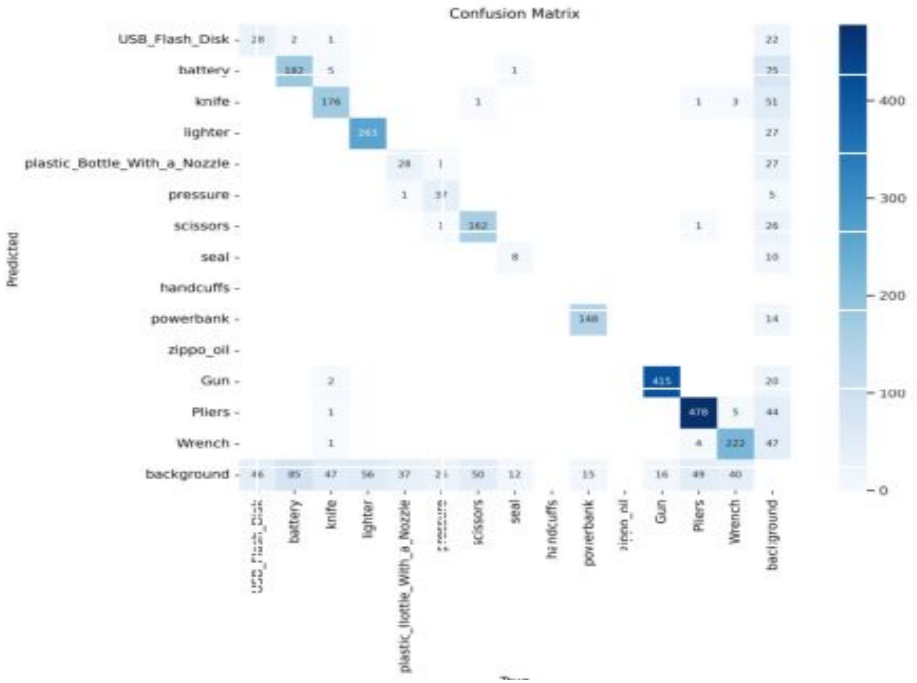

YOLOv8
RangeKing
Backbone
YOLOv8 Backbone (P5)
Head
YOLOv8Head
Loss
Details
C2f
Bottleneck
SPPF
Conv
Detect
Backbone
Head


YOLO-NAS
Neural Architecture Search
Accuracy vs. Latency
Accuracy (mAP@0.5:0.95)
Latency (ms)
deci
Backbone
STEM
STAGE 1
STAGE 2
STAGE 3
STAGE 4
SPP
Neck
UP STAGE 6
UP STAGE 5
DOWN STAGE 7
DOWN STAGE 8
Head
Detect Head
Detect Head
Detect Head
Width multiplier = 0. 5
QSP Block
QCI Block
CBR 1x1
2XQARepVGG
concat

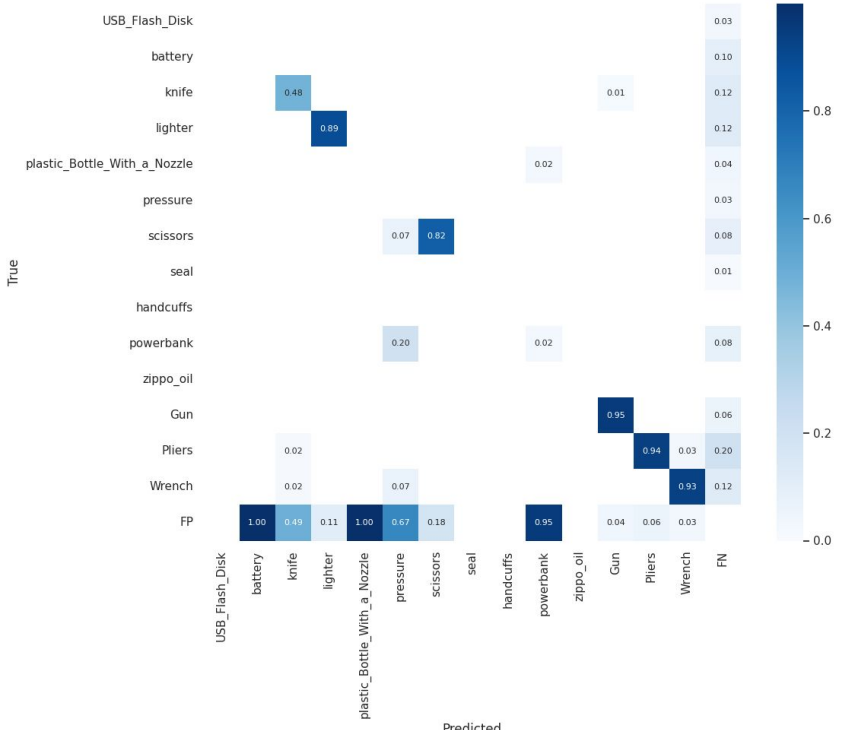
Experimental Results

	mAP	Precision	Recall	F1 Score
Basirah - Yolo v8	76.2%	86.5%	62.3%	72.4%
Basirah - Yolo nas	66.88%	11.60%	86.77%	20.47%

Experimental Results

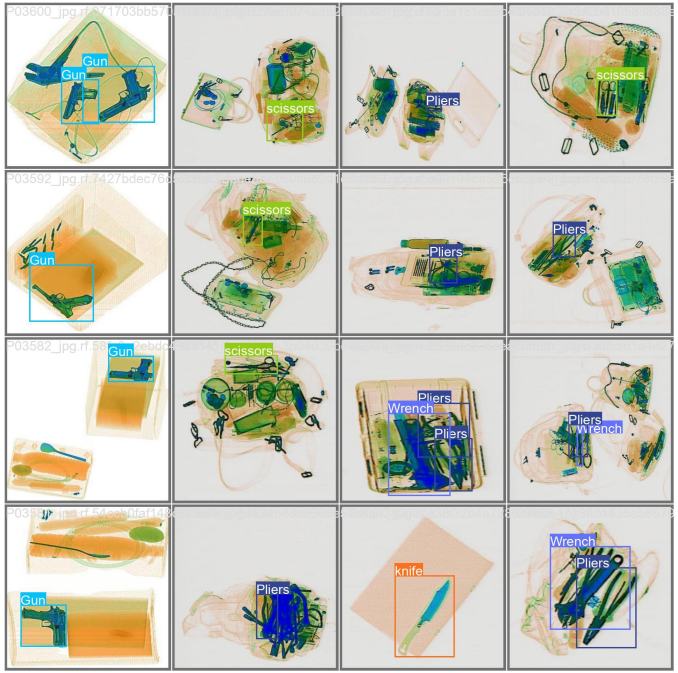


YOLO-v8

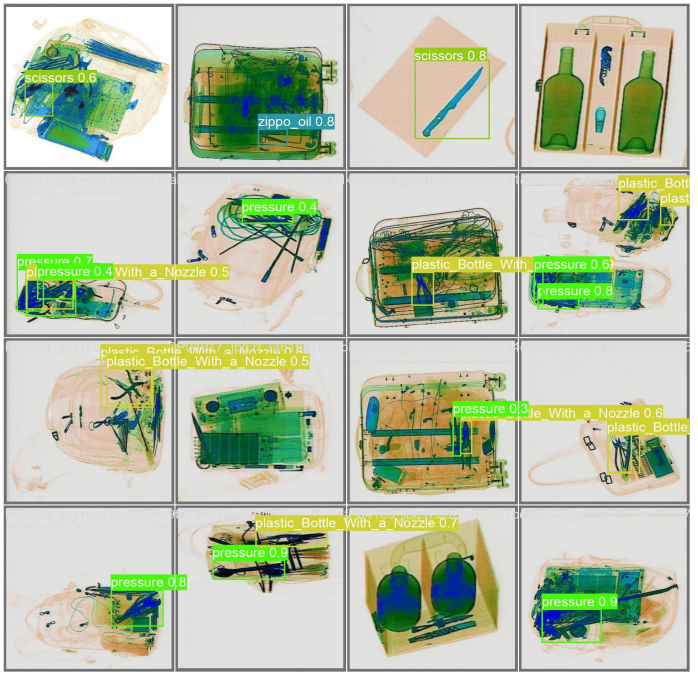


YOLO-nas

Experimental Results



YOLO-v8

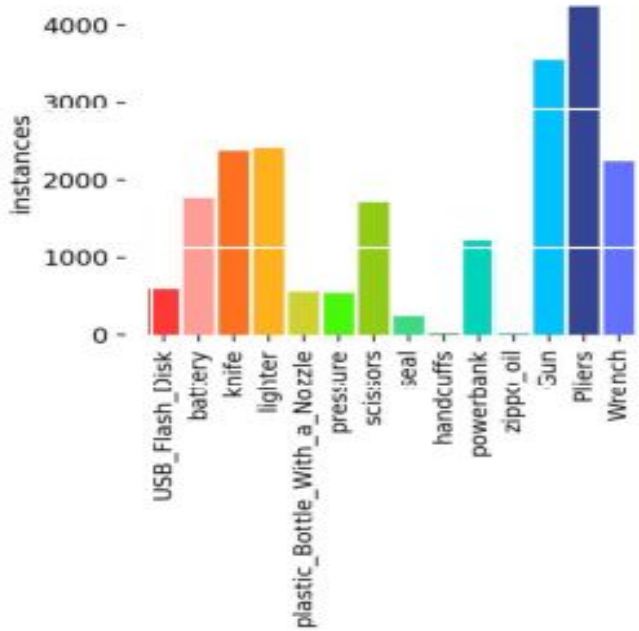


YOLO-nas

Competitor Analysis

	Num of classes	mAP
XAD (Physical Adversarial Object Attacks) -2023	4	91.74%
Towards Real-world X-ray Security Inspection - 2021	5	90.6%
Occluded Prohibited Items Detection - 2020	5	82.41%
Towards Real-World Prohibited Item Detection - 2021	12	71.2%
Basirah - Yolo v8 (ours)	14	76.2%
Basirah - Yolo nas (ours)	14	66.88%

Class distribution of our dataset



Conclusion and Future work

THANK YOU!