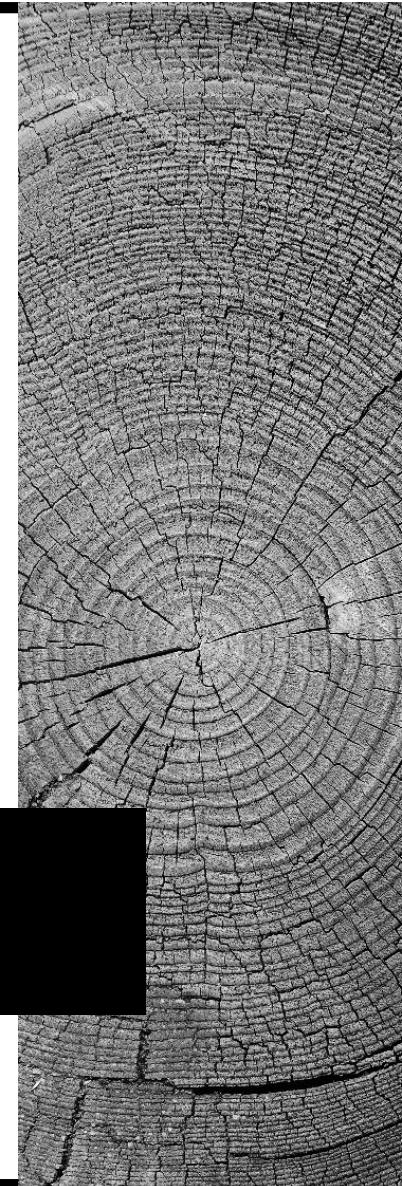


# THERMAL IMAGE SEGMENTATION AND ANNOTATION

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*Date: 12/10/2020*



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**What is  
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# PROBLEM

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**VISION CAMERA IS LIMITED  
IN SITUATION WITH LOW  
LIGHT AND HAS LIMITED  
RANGE OF VISIBILITY**



**LOW VISIBILITY IN ADVERSE  
CLIMATE SUCH AS FOG AND  
RAIN**

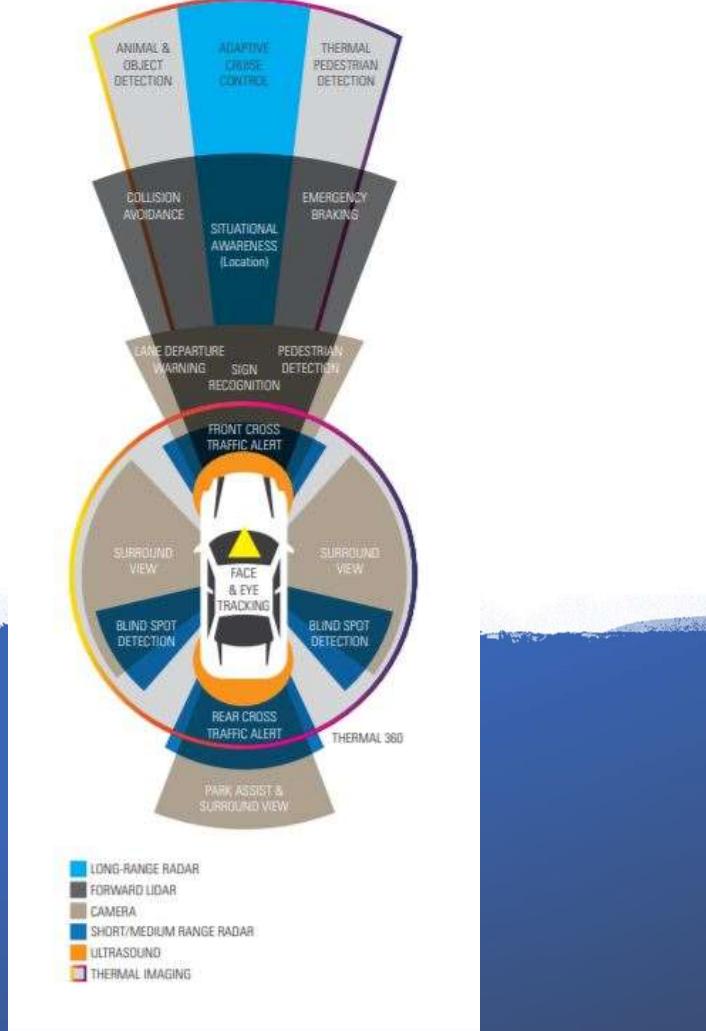


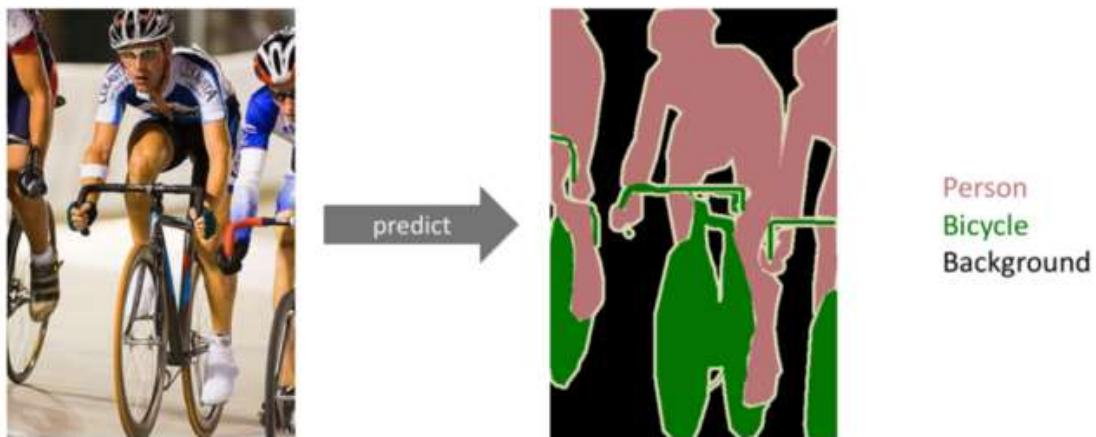
Table 1. Detector technologies and application summary

Application	Visible	Thermal	Radar	LIDAR	Ultrasound
Traffic Sign Recognition	X				
Adaptive Cruise Control			X		
Lane Departure Warning	X				
Front Cross Traffic Alert		X	X		
Emergency Brake Assist	X	X	X	X	
Pedestrian/Animal Detection	X	X			
Pedestrian/Animal Classification	X	X			
Night Vision		X			
Blind Spot Detection		X	X		X
Rear Collision Warning			X		
Park Assist	X				X
Mapping/Location				X	
Rear Cross Traffic Alert		X	X		X
Rear AEB					X
Collision Avoidance	X	X	X	X	
Surround View	X	X			

<sup>3</sup> <https://www.ntsb.gov/investigations/AccidentReports/Reports/HWY18MH010-prelim.pdf>

<sup>4</sup> <http://www.brakingdistances.com>

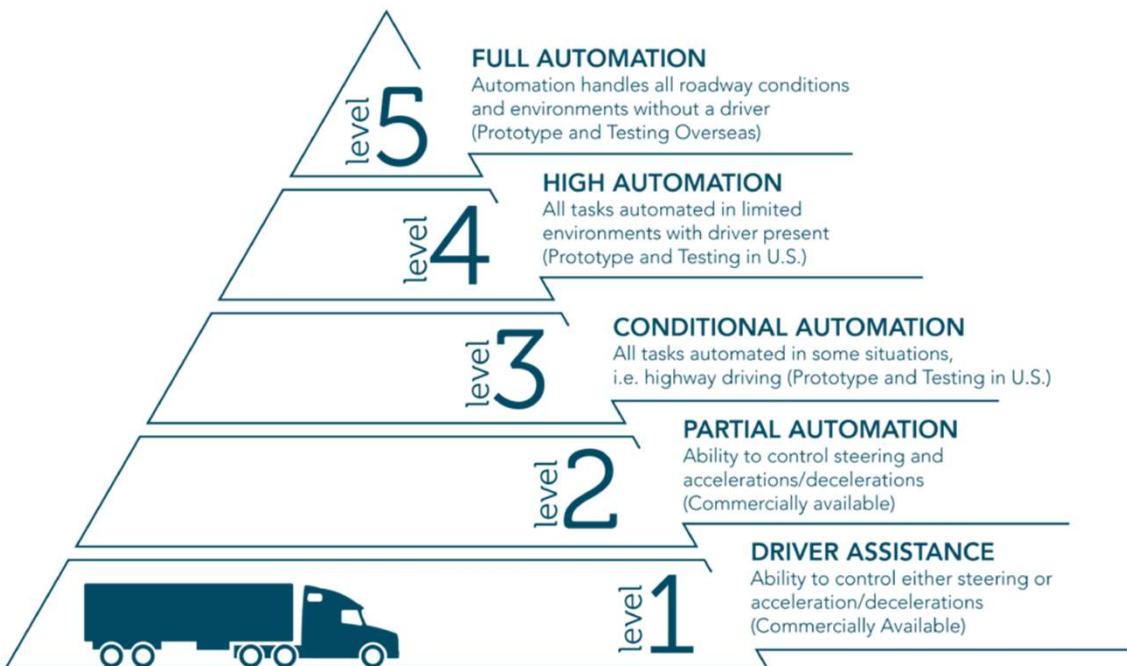
# What is Segmentation



[2]

- **Pixel level labelling of different classes in an image**
- **Output is not a number, bounding box or other parameters; It's an Image almost the same size as the original**

# Why is it important



- **Supplements the goal of a vision camera**
- **Acts as a backup**
- **Functional in a wide range of scenarios**
- **Segmentation adds to the localization of features in the image leading to better scene understanding**



[4]

## Infrared Based Thermal Imaging

- Can read heat emitted by objects even through materials, not sensitive to adverse climate conditions and occlusion
- Low FOV IR cameras have an extended range of visibility
- Not dependent on a light source to illuminate the object in frame

# APPROACH

- Considering the application of thermal cameras in ADAS, we test the accuracy in segmentation of pixel labels for pedestrians and cars classified into a single class as obstacles.
- Provide a binary mask as segmentation for the original images through various techniques

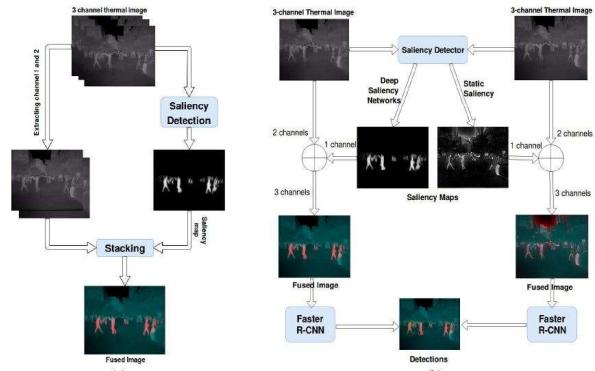
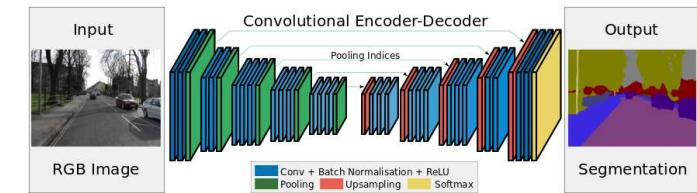
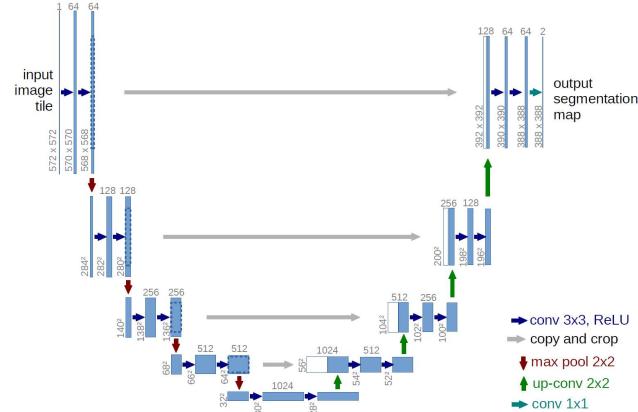


Figure 1. (a) Procedure for augmenting thermal images with saliency maps, (b) Faster R-CNN training procedure on augmented images



[5]

**Saliency maps**

**UNet**

[6]

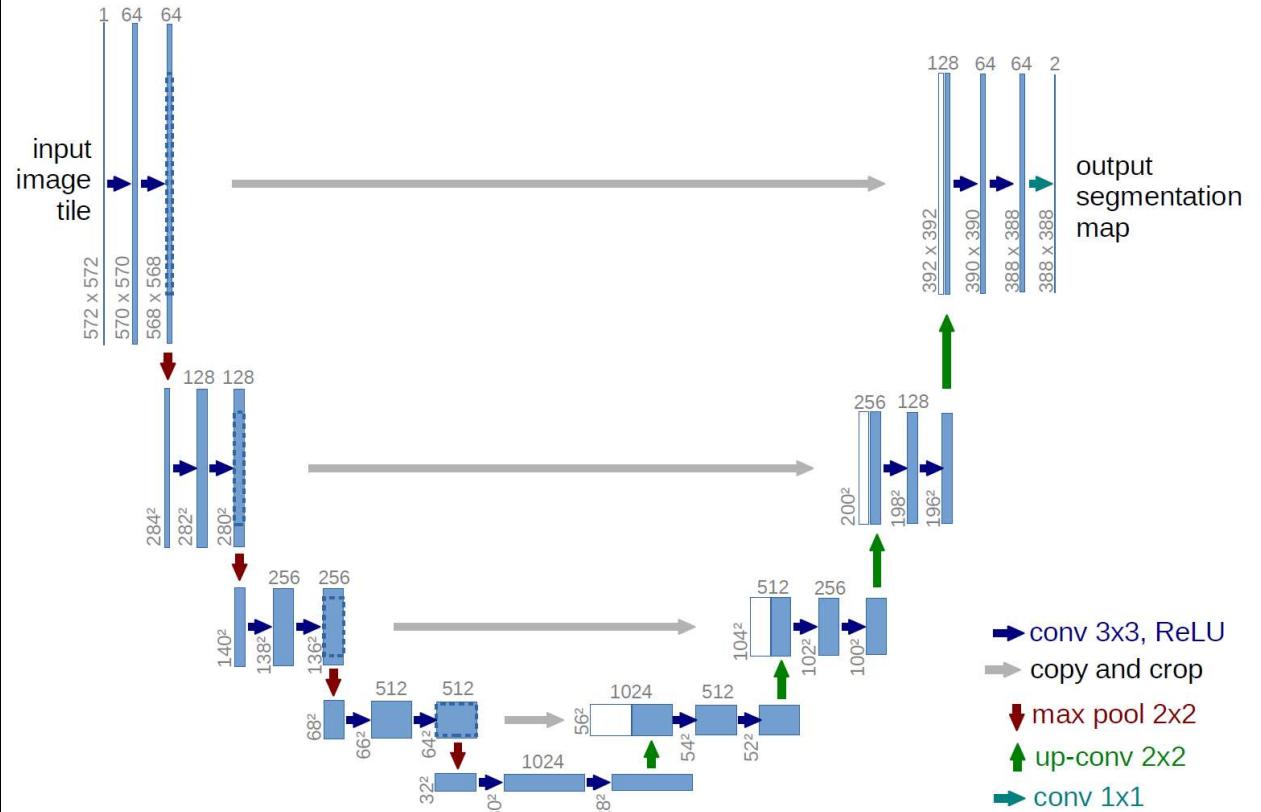
**SegNet**

[7]

# Segmentation specific architectures

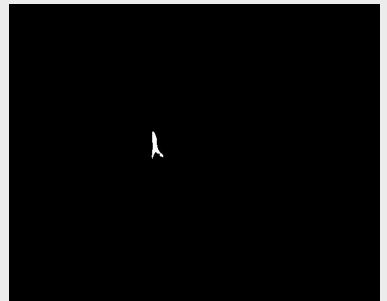
# UNET ARCHITECTURE

- **2 Layered convolutional blocks, kernel size of 3x3, activated using a ReLU function and passed through Batch normalization.**
- **This is then passed through a series of two different path with the first path going through down sampling and up sampling to end with a convoluted segmentation map.**

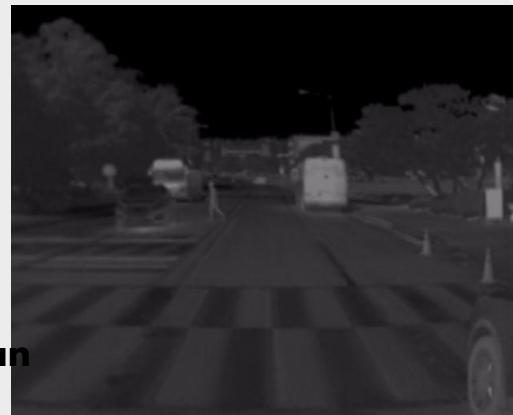


# DATASETS

- **NUANCE Autonomous car Dataset[10]**



- **KAIST Multispectral Pedestrian Detection Benchmark[9]**



- **Annotations for KAIST Salient Pedestrian Dataset[8]**

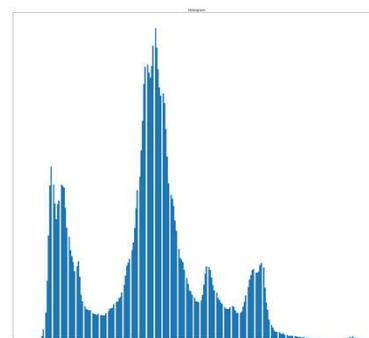
# PREPROCESSING

- **K-means Clustering[14]**



- **Canny edge detection[11]**

- **Global threshold[12]**



- **Otsu Threshold[13]**

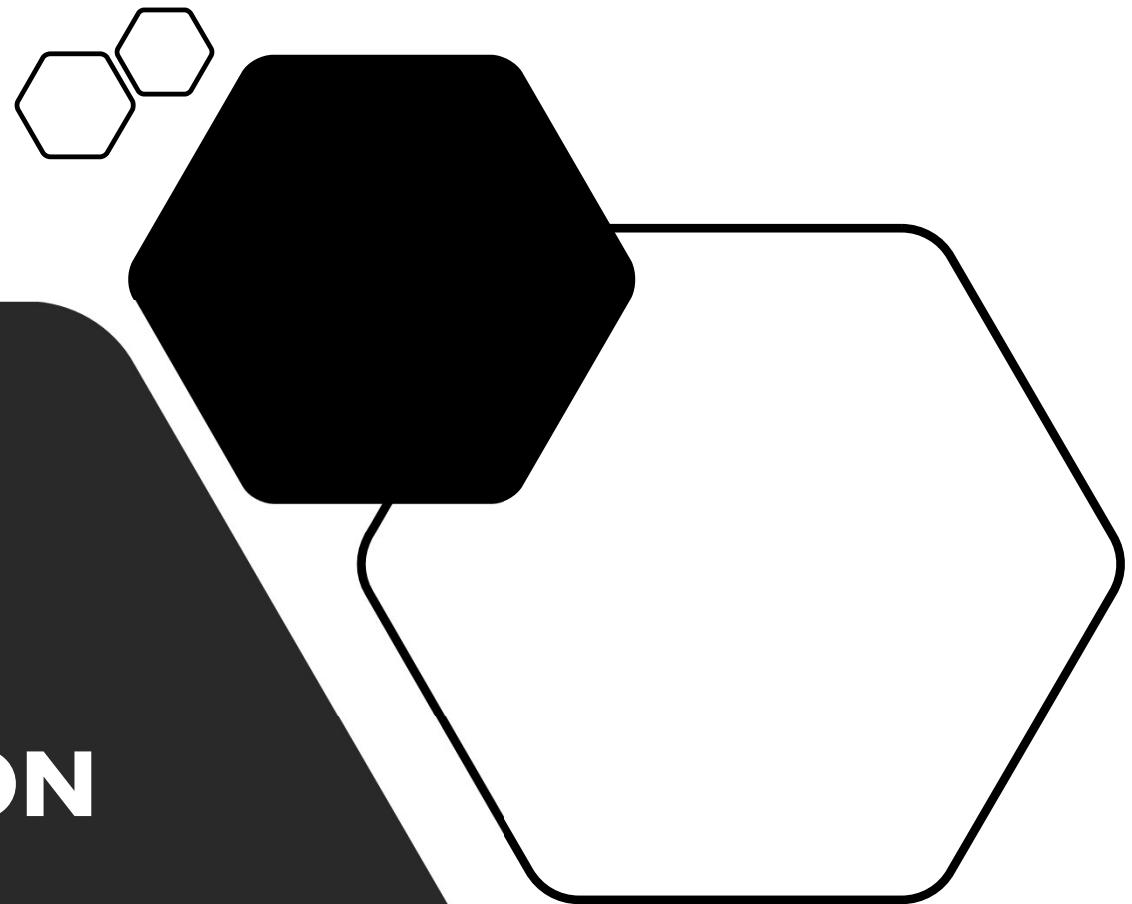
# **BEST METHOD (chosen for this project)**

- To Zero Threshold[15] with Binary filter  
(based on a Qualitative evaluation)

## **Alternative Methods**

- Otsu's Threshold and Canny edge detection could also be effective

# MODEL IMPLEMENTATION



# EXPERIMENT STEPS



**Step 1:**  
**Annotations for**  
**KAIST Salient**  
**Pedestrian**  
**Dataset**

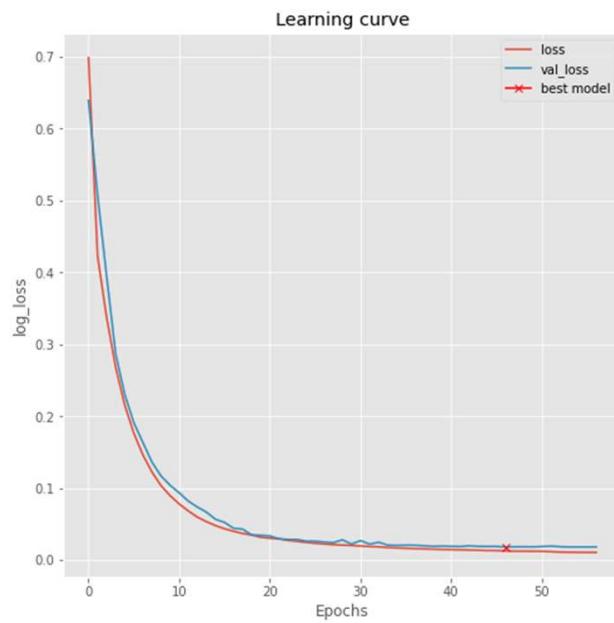


**Step 2:** Results  
from this step is  
used as a  
benchmark to  
test the second  
dataset.

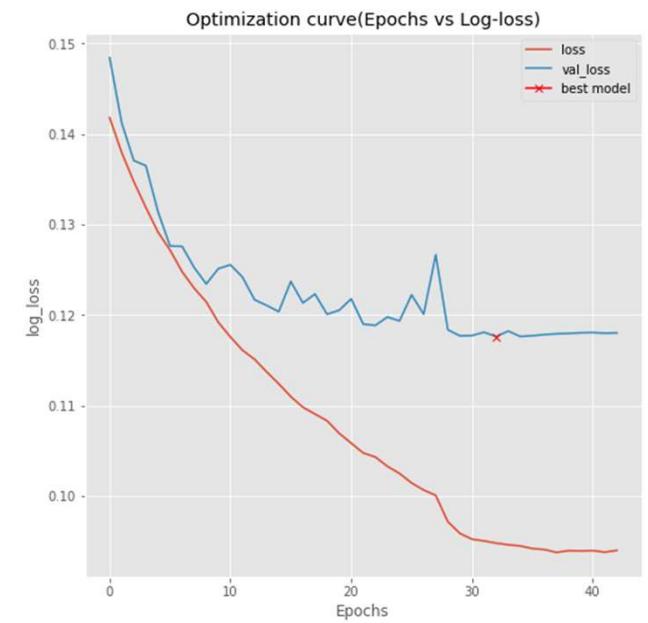


**Step 3:** The same  
architecture is  
used to test the  
second dataset  
from NUANCE

# RESULTS



Benchmark Dataset



NUANCE Dataset

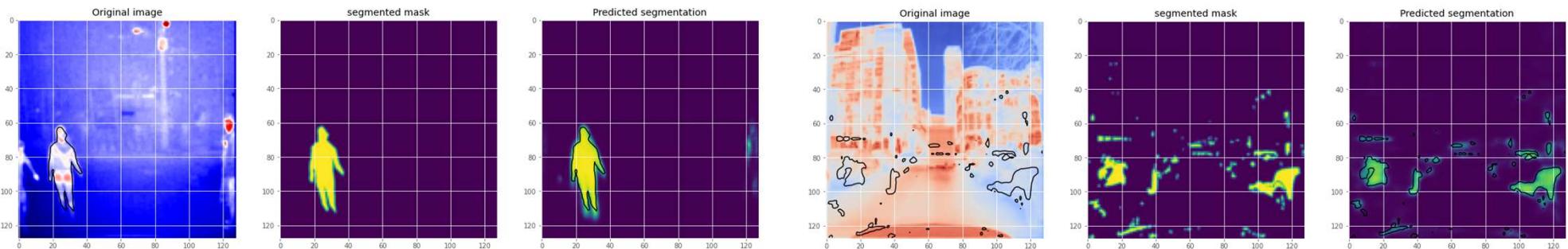
Binary Cross-entropy value:

**0.0172**

**0.118**

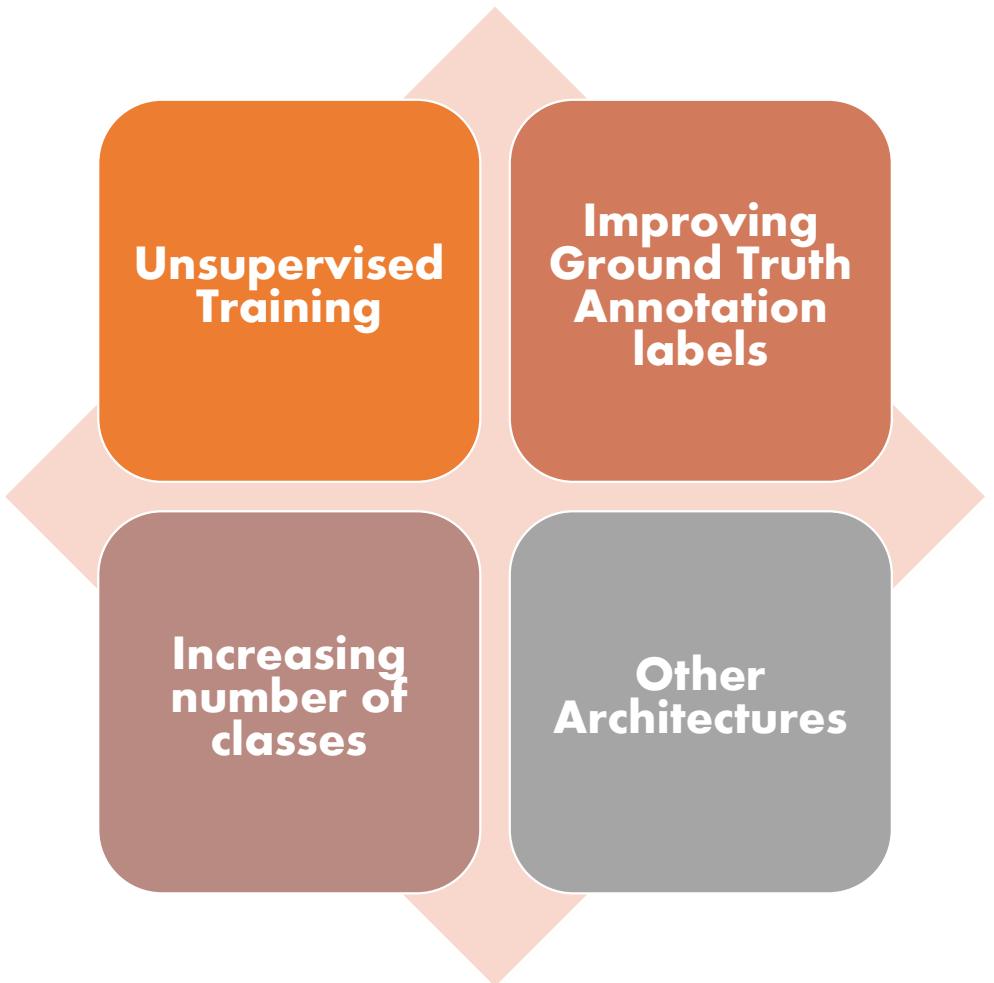
# CONCLUSION

- **ADAS**
- **INDUSTRIAL APPLICATIONS**
- **LAW ENFORCEMENT AND MONITORING**
- **MEDICAL IMAGING**



# WHAT'S NEXT

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