

CHI Software

R&D Center

Comparative research

Summary

Due to the high interest in facial recognition APIs among our customers, we decided to conduct a research study. In this study, we compare how three well-known cloud services perform under identical conditions in cases of head rotation or partially visible faces to determine the quality for the task of face recognition.

For our research, we have chosen three Cloud APIs that provide face recognition functionality:

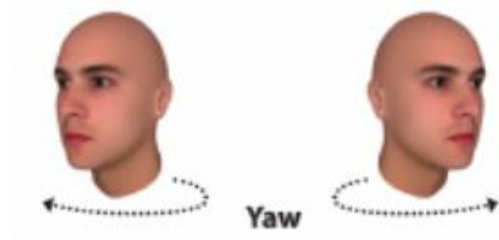
- Azure from Microsoft
- AWS from Amazon
- Kairos (which claims to be the leading Edge AI)

It is worth mentioning that the face recognition task goes hand in hand with the face detection task, which means we have to find the face on the image first and then compare it to another face (or faces) to determine whether there is a match. We found several cases when face detection technology failed for different reasons and matched the results with Cloud API.

Dataset for the experiment

1) The dataset for analyzing of yaw and yaw/pitch face detection accuracy was formed based on an open Head Pose Database. We used 3 persons with 11 different angles (33 unique pictures in total):

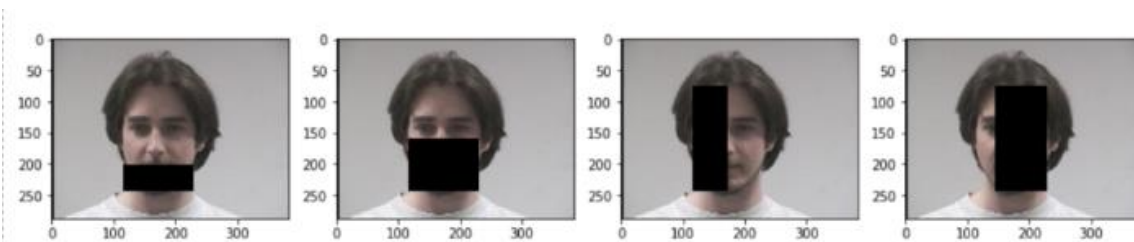
- Pitch -90 degrees, yaw 0 degrees ($-90+0$);
- Pitch -60 degrees, yaw $+75$ degrees ($-60+75$);
- Pitch -30 degrees, yaw $+60$ degrees ($-30+60$);
- Pitch $+0$ degrees, yaw -45 degrees ($+0-45$);
- Pitch $+0$ degrees, yaw -15 degrees ($+0-15$);
- Pitch $+0$ degrees, yaw $+0$ degrees ($+0+0$);
- Pitch $+0$ degrees, yaw $+15$ degrees ($+0+0$);
- Pitch $+0$ degrees, yaw $+45$ degrees ($+0+45$);
- Pitch $+30$ degrees, yaw -60 degrees ($+30+-60$);
- Pitch $+60$ degrees, yaw $+75$ degrees ($+60+75$);
- Pitch $+90$ degrees, yaw $+0$ degrees ($+90+0$)



- 2) The group photo dataset was formed of 108 images with a minimum of 6 people present in each.



- 3) For partially visible faces detection we created a set of 158 images.



- 4) We used the following formulas to calculate both parameters:

Accuracy – Percentage of the correct predictions of the model. This number lies between 0% and 100%, where 0% means the model doesn't return any correct predictions, and 100% means all predictions of model are correct.

$$\text{Accuracy} = (<\text{amount of correct predictions}> / <\text{amount of all predictions}>) \times 100\%$$

Adjusted accuracy – Accuracy with considering not-found faces. Very often, services can't find faces on some images. In adjusted accuracy, all not-found faces will be considered as false predictions of the model. (In regular accuracy, we don't consider not-found faces at all.)

$$\text{Adjusted accuracy} = (<\text{amount of correct predictions}> / (<\text{missed comparing}> + <\text{amount of all predictions}>)) \times 100\%.$$

The matching matrix and the results for face detection

The API name	Cases:			
	Head rotation threshold	Mixed case of rotation and staring up or down	The group photos (max people number)	Partially visible faces
Azure	$\leq 60^\circ$	$\leq 45^\circ$	≤ 6	$< 2\%$
Kairos	$\leq 80^\circ$	$< 80^\circ$	As in data set, but with false positive	$< 90\%$
AWS	$< 90^\circ$	$< 90^\circ$	No limit	100%

Similarly, we compared face recognition accuracy by applying the appropriate API to detect faces. Through comparison, we have created simply the head rotation cases with several angle brackets, a separate case for partially visible face, and several cases related to the face size.

The face recognition comparison results

The API name	Cases, accuracy:						
	Rot $< 60^\circ$	$60 < \text{Rot} < 75^\circ$	$75 < \text{Rot} < 85^\circ$	Partially visible faces (Accuracy vs Adjusted accuracy)	Face side $< 25 \text{ pxl}$	$25 < \text{Face side} < 50 \text{ pxl}$	Face side $> 50 \text{ pxl}$
Azure	98.5%	39.2%	39.2%	96% / 20%	0%	36%	100%
Kairos	88.5%	73.2%	73.2%	91.7% / 34.1%	0%	53%	100%
AWS	94.5%	94.5%	94.5%	91.5% / 63.5%	63%	100%	100%

Please note that these values include the detection rate as well. So, let's say, for partially visible faces only, Azure can detect faces in only 20% of cases. Still, when the face has been detected, there is the possibility of recognizing a particular person with a probability of 96%. This means the recognition part by itself works pretty well, but it gives less accurate results when combining with detection. So, if you see in the table only one number, it already includes the detection rate; otherwise, recognition vs. detection and recognition are shown.

Since face detection makes such a significant impact on the overall performance, we decide to check how face detection works in cases when the image is rotated around a Z-axis (roll). This time, we decided to take AWS and Kairos only since Azure doesn't perform well and can't compete when the image is rotated.

The API name	The detection percentage	
	Image with no rotation	Image rotated with different angles
Kairos	82%	24%
AWS	96.1%	96.1%

The conclusion

According to the results, the recognition part of AWS might be a little bit worse than other Cloud APIs; however, the face detection part works much better than in other similar services. This leads us to the conclusion that for the full pipeline task, like face extraction and person identification, AWS is the best choice among those we compared.