




Carmen® Make & Model Recognition MMR Brief Description

MMR RESULTS:



MAKE & MODEL RESULTS:

Attribute	Value	Confidence
MAKE:	AUDI	100%
MODEL:	A8	95%
COLOR:	GREY	96%
CATEGORY:	CAR	99%
HEADING:	FRONTAL	98%

ANPR RESULTS:



ANPR RESULTS:

Attribute	Value	Confidence
License Plate	CU 22 069	100%
COUNTRY:	DENMARK	99%
MAIN BACKG. COLOR:	LIGHT	98%
MAIN FONT COLOR:	DARK	95%

The Make and Model Recognition (MMR) module enables the precise identification of a vehicle's make, model, generation, and other detailed attributes based on digital images. The documentation provides a detailed overview of the supported categories, color configurations, available settings, and the optimal camera setup for excellent recognition results.

Carmen® MMR

BRIEF DESCRIPTION

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WHAT IS MMR?

The Make and Model Recognition (MMR) module enables its users to retrieve additional information from a digital image.



There are two modes to call the module:









- triggermode = 0
In this mode the ANPR input is optional (but recommended for best performance). The module also detects the vehicle using its internal detectors, enabling MMR features when the numberplate is not provided. Please note, that BodyType results and the full functionality of the ViewPoint property are exclusive to this mode.
- triggermode = 1
In this mode the ANPR input is mandatory, and the MMR modul only relies on this information to locate the vehicle on the image.



The MMR result includes the following attributes of the vehicle:








- Make (VW, BMW, Toyota, etc., overall 240+)
- Model (Passat, X5, Granvia, etc, overall 1700 +)
- Generation (Mk VIII 2020, Mk X 2017|2020, etc., overall 6000 +)
- Dimensions: width, height, length (if the generation information is available)
- Categories
 - UNK (Unknown)
 - CAR (Car)
 - BUS (Bus)
 - HVT (Heavy truck)
 - LGT (Light truck)
 - MTB (Motorbike)
 - VAN (van)
 - TRUCK (Truck)
 - PICK-UP (Pick-up)
 - CARAVAN (Caravan)
 - TRAILER (Trailer)
 - INDUSTRIAL (Industrial)
 - TUKTUK (Tuktuk)
 - MILITARY (Military)



The following table contains the definitions of all categories, illustrated with descriptions and sample images.







Category	Description	Sample
<p style="text-align: center;">CAR</p>	<p>Personal vehicles with defined bodytypes, such as sedan, SUV, hatchback, combi/wagon, MPV, coupe, convertible, liftback. Note, that the PICK-UP style SUV-s like the one on the left are considered as CAR not as a PICK-UP. We classify a vehicle PICK-UP only, when the trunk does not have a lift-up tail gate.</p>	
<p style="text-align: center;">BUS</p>	<p>With the exception of a minibus, all means of on road public transport vehicles are classified as BUS.</p>	

<p>HVT</p>	<p>Heavy Truck</p>	   
<p>LGT</p>	<p>Light Truck</p>	   

<p>MTB</p>	<p>Means of two-wheel personal road transport.</p>	
<p>VAN</p>	<p>Small utility vehicles and minibuses. The smaller VAN types on the left, from a frontal view, when the rear part is not yet in the frame, can be classified as CAR, because the difference between e.g.: an MPV bodytype CAR and a VAN is not yet visible.</p>	

<p>TRUCK</p>	<p>"Obsolete It used to be: Large personal utility vehicles, with varying rear builds. In engines from 2023 and later, such vehicles will be classified either as PICK-UP, or will be further divided to new categories".</p>	   
<p>PICK-UP</p>	<p>Personal vehicles with open rear trunk space.</p>	  

<p>CARAVAN</p>	<p>Towable and compact caravans.</p>	
<p>TRAILER</p>	<p>Small towable extensions. Towed extensions on a HVT or LGT with the same wheel size will be categorized as HVT or LGT. (the difference is only visible from the side).</p>	

<p>INDUSTRIAL</p>	<p>Purpose built large vehicles for industrial usage, such as cranes, concrete pumps, etc...</p>	   
<p>TUKTUK</p>	<p>Small, three-wheeled motorized vehicle, also known as rickshaw, bajaj, or mototaxi, depending on the region.</p>	 

MILITARY

Armored and tactical vehicles designed for defense, troop transport, and combat support in rugged terrains.



- Colors:

Color	Standard Color	RGB Code
SILVER	LIGHT_GRAY	0xbfb7bd
GRAY	DARK_GRAY	0x585458
BRONZE	BROWN_ORANGE	0x0e468b
BURGUNDY	BROWN_RED	0x0f248a
TURQUOISE	GREEN_BLUE	0xaeae13
BLUE	BLUE	0xbd6c27
STEEL_BLUE	GRAY_BLUE	0x997f66
GREEN	GREEN	0x23a939
YELLOW	YELLOW	0x21dde8
GOLD	ORANGE_YELLOW	0x2faed9
LIME	GREEN_YELLOW	0x33ccbd
ORANGE	ORANGE	0x2781ea
CORAL	ORANGE_RED	0x3b5ddb
RED	RED	0x0000cc
ROSE_RED	RED_PINK	0x4f26d9
ROSE_GOLD	BROWN_PINK	0x8a80c5
PINK	PURPLE_PINK	0xcd83f4
BROWN	DARK_BROWN	0x071a57
TAN	LIGHT_BROWN	0x7b92a4
PURPLE	RED_PURPLE	0x703d8f
VIOLET	BLUE_PURPLE	0x8f3d5a
BLACK	BLACK	0x000000
DARK_GRAY	BLACK_GRAY	0x343234
DARK_BROWN	BLACK_BROWN	0x242b42
DARK_GREEN	BLACK_GREEN	0x244228
DARK_PURPLE	BLACK_PURPLE	0x42242e
DARK_BLUE	BLACK_BLUE	0x663000
WHITE	WHITE	0xffffffff
PALE_GRAY	WHITE_GRAY	0xe7e4e6
CHAMPAGNE	WHITE_BROWN	0xcdcf0
CREAM	WHITE_YELLOW	0xcef4ff
PALE_BLUE	WHITE_BLUE	0xe6e0b3
PALE_GREEN	WHITE_GREEN	0xd0ecc6
PALE_PINK	WHITE_PINK	xe9d9f2

- ViewPoint:
 - front
 - rear
 - front_side (triggermode 0 only)
 - rear_side (triggermode 0 only)
 - top (triggermode 0 only)
 - top_side (triggermode 0 only)
 - side (triggermode 0 only)
- BodyType (triggermode 0 only)
 - Sedan
 - SUV
 - Hatchback
 - Combi/Wagon
 - MPV
 - Coupe
 - Convertible
 - Liftback

 Hint

Apart from the main result attributes above, in some cases we can detect anomalies of the input data, that might cause decreased performance. These are returned either as frame tooltips or image tooltips, depending on the scope of the detected anomalies.

- ID=1: The vehicle is rotated.
- ID=2: The vehicle is out of/close to image borders.
- ID=3: This image might have too low brightness settings.
- ID=4: This image might have high intensity lighting conditions.
- ID=5: This image might have a green bias.
- ID=6: This image might have a yellow bias.
- ID=7: This image might have severe reflections.
- ID=8: Dark image. The vehicle contours may not be visible.

User properties:

- **viewPoint:** In case the MMR module is used in a fixed setup, where the viewPoint of the vehicle is known, one can specify this property from the above viewPoint options.
- **independent_classification:** In some cases, despite the category or the viewPoint of the vehicle is uncertain, other features like vehicle color can be determined. If this property is set to 0, the MMR result is marked invalid, unless at least the viewPoint and the category attributes are known. If this property is set to 1, the MMR result is valid if any information is available.
- **processed_mm_frame:** When using detectors in triggermode 0, there can be multiple frame candidates to run the make and model recognition within a single vehicle bounding box. To clarify which frame was used during inference, this property returns the processed frame coordinates.
- **<...>_alias:** This property allows the user to give an alias to the main MMR properties above: e.g.: color_alias, category_alias, bodyType_alias. The value should be in the following format: "<original_value>:<alias_value>;<original_value>:<alias_value>". For example: <color_alias value="RED:red;BLUE:blue"/> if one would like to have the RED value of color property transformed to red and the BLUE value to blue. Please note, that the alias name and the original values should match an existing MMR attribute and a valid attribute value because otherwise the alias property is ignored.
- **soft_roi_polygon:** An arbitrary polygon can be provided to filter the returned results. In order to include a vehicle in the result, its license plate (or the usual area, where the license plate is installed) must be fully contained within the polygon. In case no license plate was detected, 80% of the vehicle's bounding box must be within the specified polygon. The word "soft" indicates, that the engine is processing the whole image without any optimizations, and then the results are filtered to fit the polygon accordingly. The coordinates should be provided in x,y order, separated by commas or semicolons, following a clockwise direction. The polygon must consist of at least 3 points. E.g.: <soft_roi_polygon value="0,0,100,0,100,100,0,100" />

- **roi_frame:** A four-point rectangle separated either with comma or semicolon, that instructs the engine to crop the image before processing. E.g.: `<roi_frame value="0,0,100,0,100,0,0,100" />`. Warning: even if the object is within the specified frame, the changed image – object relation can result in a different result when it comes to detections. Recommended only, when optimizing for recognition speed on large images, in other scenarios use "soft_roi_polygon" instead.

Properties available from 25Q1:

- **fixed_camera_position:** In case the installation is static, and the engine is processing events on the same location, from the same angle, this property allows the engine to optimize its internal algorithm based on historical data. Possible values: 1-ON, 0-OFF.
- **detector_only:** This property enables the user to load the engine only with the components necessary for vehicle detection, decreasing the load time and the memory footprint. Possible values: 1-ON, 0-OFF.

SETTING UP YOUR CAMERA FOR MMR

For optimal MMR results, the camera should be mounted over and parallel to the traffic. In other words, to ensure that all minor details of the vehicle are captured, it is best to minimize the natural obstructions and blockages of the viewpoint. In case the local premises do not allow the optimal installation, our engine can still sort out the majority of the properties right, but the accuracy can suffer.

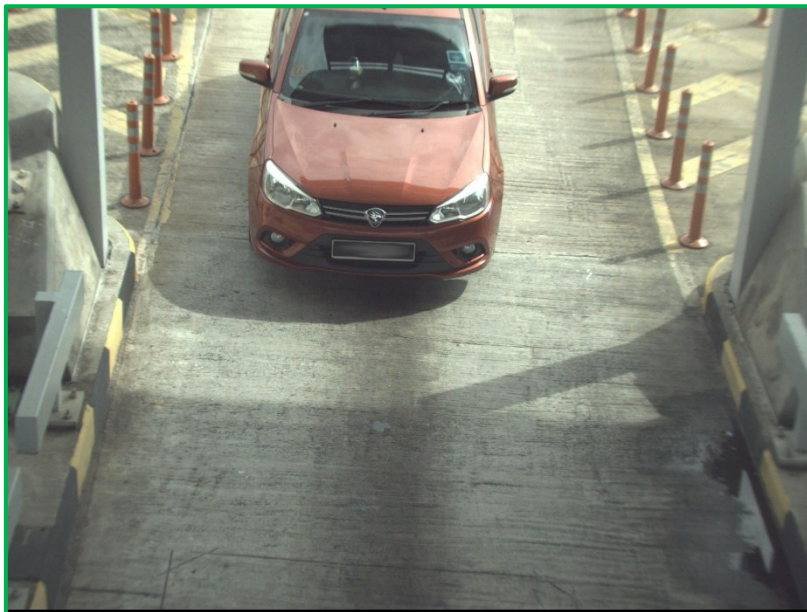


Illustration 1: Correct setup example



Illustration 2: Correct setup example



Illustration 3: Viewpoint blocks the symmetries of the vehicle

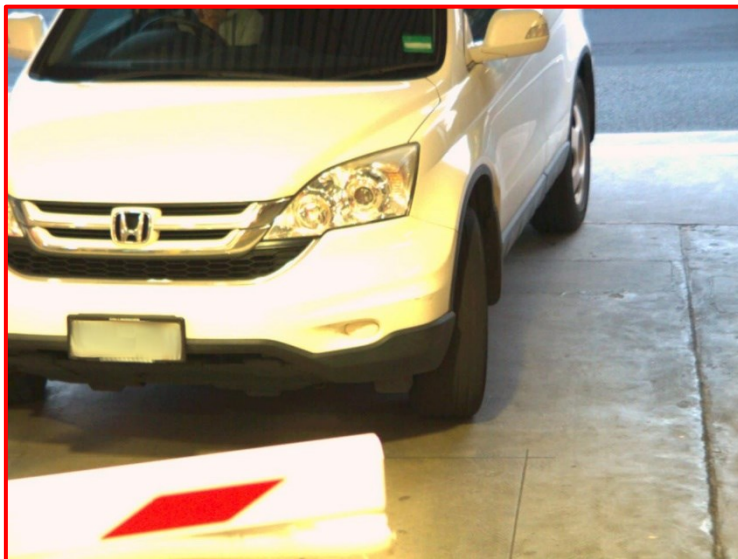


Illustration 4: Vehicle is out of frame

Our MMR engine can successfully classify vehicles on all scales from full zoom to a multi-lane setup as long as all the important parts are within the frame. For easing the setup process, and determining what "important" means, the engines provide a feedback mechanism, as detailed in [Carmen ANPR Reference Manual](#).



Illustration 5: Correct single-lane setup



Illustration 6: Correct multi-lane setup

INPUT REQUIREMENTS OF MMR

The input data for MMR consists of two main components: Image and ANPR. For further details on the interface and on ANPR, see [Carmen ANPR Reference Manual](#).

Our MMR engine is prepared for several lighting conditions during daytime, and can even function after sunset, if proper night time lighting is in place.



Illustration 7: Correct setup for lower lighting conditions

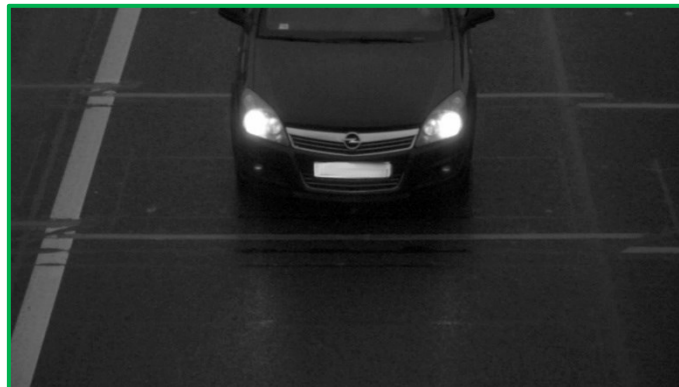


Illustration 8: Correct setup for night time

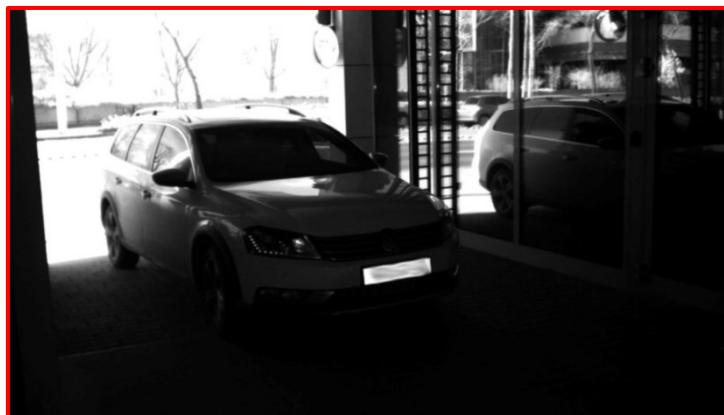


Illustration 9: Incorrect setup for night time

The aspect ratio of the input image should remain in its original state.



Illustration 10: Correct, original aspect ratio

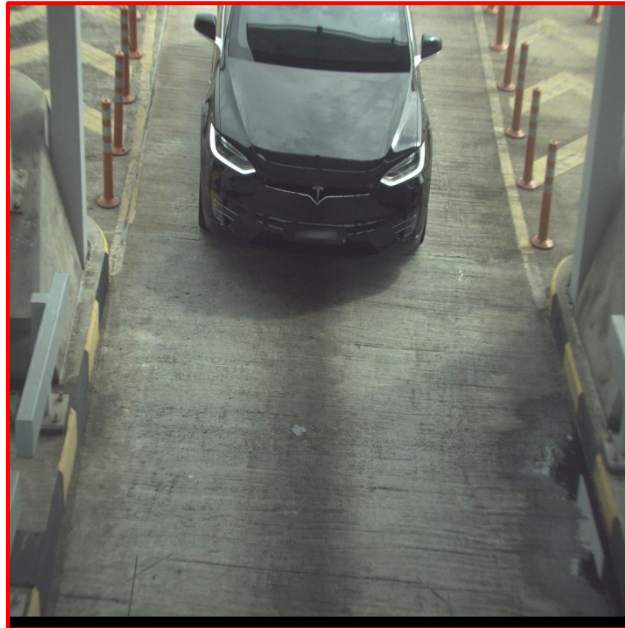


Illustration 11: Incorrect aspect ratio

Most cameras have adjustable color parameters. It is important to note, that in reaching optimal color recognition, these settings can play a very significant role, and by tuning them to a natural setup, the accuracy can be significantly improved.

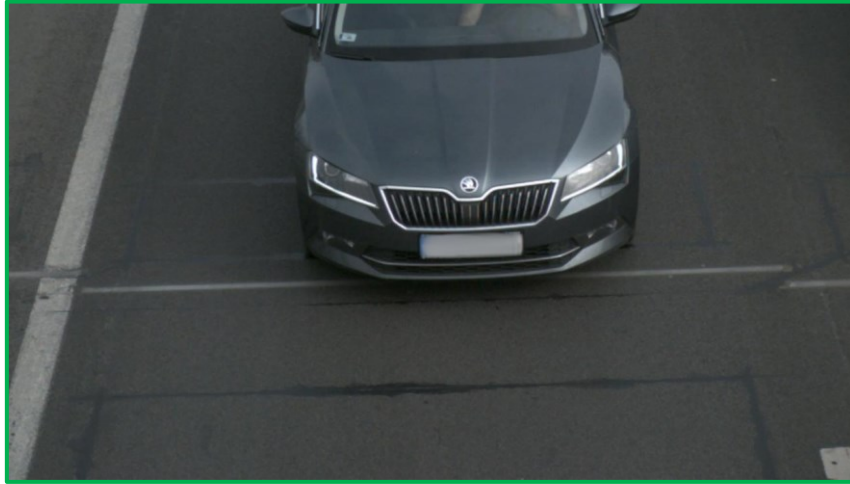


Illustration 12: Correct color settings



Illustration 13: Imbalanced color settings

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