

2 Project description

2.1 Context

The creation of this prototype is part of the development of applications to support the detection of the entrances of people and means of transport within delimited areas in the city. The information on the detected entrances is then processed for various purposes, from the detection of possible infringements (in the case of areas subject to restrictions on access by people or vehicles), to the calculation of costs for possible tolls, to the simple recording of entrances for statistical purposes.

2.2 Hardware and documentation

The card used is OAK-D CM4:

<https://shop.luxonis.com/products/oak-d-cm4?srltid=AfmBOoq52yooHI9ATj0Sj759NuoJ9Jt2raYGHGTc3YIDUuZ-DQH-ATpM>

2.3 Description

The prototype must be able to detect the entrance, in a specific area, of pedestrians or vehicles; he will have to recognize and isolate the moving object that must be tracked from when it enters the range of the lens to when it exits. For vehicles, it must be able to identify the type of vehicle as indicated by

https://it.wikipedia.org/wiki/Classificazione_dei_veicoli#Italia and detect its speed.

2.4 Input and output

Input:

- a time interval
- the delimitation of an area (it could be the entire area framed by the camera or a subset of it if we can provide elements to define it).

Output:

for that time interval, the tracking of pedestrians and vehicles that crossed the area. To obtain the tracking, each pedestrian and vehicle must be associated with a unique identification code, starting with P for pedestrians and V for vehicles, and each identifier must be associated with a list of positions.

In addition, each moving object that enters the camera's range must have an associated class depending on the silhouette (person or a type of vehicle).

In the case of a vehicle, it must also have the license plate associated with it.

The positions must contain a progressive number that allows the reconstruction of the route taken and the coordinates to be able to place it in the empty image and the current speed obtained using the distance with the previous position.

Some predetermined lines must be defined in the field of action of the camera lens: if the trajectory of the traced object intersects them, that object must be associated with a specific label for each of the predefined lines that its trajectory has intersected.

2.5 Expected results

A text file for each day of operation of the system, with the list of pedestrians and vehicles detected and for each of them the positions detected. Specifications and examples follow.

A related image must also be saved each time a row is produced; in case several objects are identified together or several positions for different objects are extracted together only one image can be saved.

NOTE for English version: in the following tables, we maintained the field name as it is in Italian version, in order to not to be confusing

2.5.1 New object identification

For each new object identified, a new progressive is assigned and a line is produced with the following format:

#field	Name	Format	Example	notes
1	pedoneVeicolo (pedestrianVehicle)	X(1)	V	can only be worth P or V
2	Progressive (progressive)	9(7)	0040001	unique progressive of the object. If the object is lost by the system and subsequently recovered, a new progressive will be associated with it
3	tipoVeicolo (vehicleType)	B* Z* V* S* C M A F* R T O X	A	The letters in the format refer to the following categories. The name of categories are in Italian : <i>veicoli a braccia, a trazione animale, velocipedi, slitte, ciclomotori, motoveicoli, autoveicoli, filobus, rimorchi, macchine agricole, macchine operatrici, veicoli con caratteristiche atipiche</i> Categories marked with * can be processed at a later date field present only in the case of a vehicle
4	Nazionalita (nationality)	X(3)	SLO, I, F	Nationality code of the vehicle as written on the license plate, empty field if the country is not indicated on the license plate field

				present only in the case of a vehicle Vehicle license plate field present only in the case of a vehicle
5	Targa (Licence plate)	X(9)	AA000AA	Vehicle license plate field present only in the case of a vehicle

Some explanations about formats:

X(1) : alphanumeric with length of 1

X(9) : alphanumeric with length of 9

X(3) : alphanumeric with length of 3

9(7): numeric with lengths of 7

Important note: if an instant is not in full lengths, for the remaining characters, space will be put. It is shown in below examples:

P0000001

V0000002AI AA000AA

V0000003MI AA00000

In the second row, “V” shows that the object is vehicle, “0000002” is the unique progressive of object (i.e the ID of object), the “A” is the type of vehicle which are written in their Italian name in the table. The “I” is for the nationality indicated in the license plate, note that the format length for nationality is X(3) and for the remaining characters, space will be inserted. “AA000AA” is for license plate. Also remember to put space if the length is less than 9

Note : in 3rd row, the space rule for incomplete length is the same as 2nd row

2.5.2 New location detected

For each new detected position of an object already recognized by the system, a line with this format is inserted:

#field	Name	Format	Example	notes
1	pedoneVeicolo (pedestrianVehicle)	X(1)	V	can only be worth P or V
2	Progressivo (progressive)	9(7)	0040001	unique progressive of the object. the same progressive indicated in the identification line is repeated

3	numPosizione (positionNumber)	9(3)	023	The number of the detected location for the object. 001 indicates the first line of position written for a given object, 002 indicates the second, and so on
4	coordinataX (XCoordinate)	9(5)	00800	indicates the horizontal position in pixels of the point representing the tracked object. The origin is on the top left
5	coordinataY (YCoordinate)	9(5)	00800	indicates the vertical position in pixels of the point representing the tracked object. The origin is on the top left
6	velocitàAttuale (actualSpeed)	9(5)	00400	indicates the instantaneous velocity calculated with respect to the previous detected point or with respect to the identification in the case of the first detected point. The speed must be indicated in hundredths of a km/h. The example value represents a speed of 4 km/h
7	distanzaTotale (totalDistance)	9(6)	000250	indicates the total distance traveled by the object with respect to its identification expressed in centimeters, the value shown in the example represents a distance traveled of 2.5m
8	tempoTotale (totalTime)	9(5)	00600	Indicates the time that has elapsed since the object was identified in seconds. The value in example refers to a time of 10 minutes

2.5.3 Crossing

In the event that an object identified by the system crosses a line previously configured in the system, an additional line must be written in the following format:

#field	Name	Format	Example	note
1	tipoRiga	X(1)	A	this value must be A
2	progressivo	9(7)	0040001	unique progressive of the object. the same progressive indicated in the identification line is repeated
3	istante (timestamp)	9(10)		Timestamp of the exact time when the crossing occurred
4	codiceLinea (lineId)	X(5)	AC001	Code of the line crossed as configured in the system

In this case, in addition, it has to be saved a frame from the camera representing the crossing of a line. All the frames have to be saved in a subfolder named “fg_aaaa-mm-gg where aaaa-mm-gg” represents the actual date (so an example of subfolder name is: fg_2024-11-18).

Each frame in the subfolder has to be saved with the name:

progressive_instant.jpeg (for example: 0040001_1731944191.jpeg)

For each day spent, therefore, in the folder configured in the system you will have the “rilevazione_aaaa-mm-dd” file and the “fg_aaaa-mm-dd” folder containing the frames relating to the crossings of the “aaaa-mm-gg” day

2.5.4 Reset

The lines described above must be inside a file named “rilevazione_aaaa-mm-dd.tt” in a folder configured on the system, where yyyy-mm-dd is today's date.

Therefore, it is provided for the creation of a new file every day and the zeroing of the progressives every certain number of days, this number of days must be written in the system configuration.