ParkinGO

Video-based parking spot detection using machine learning

Teammembers

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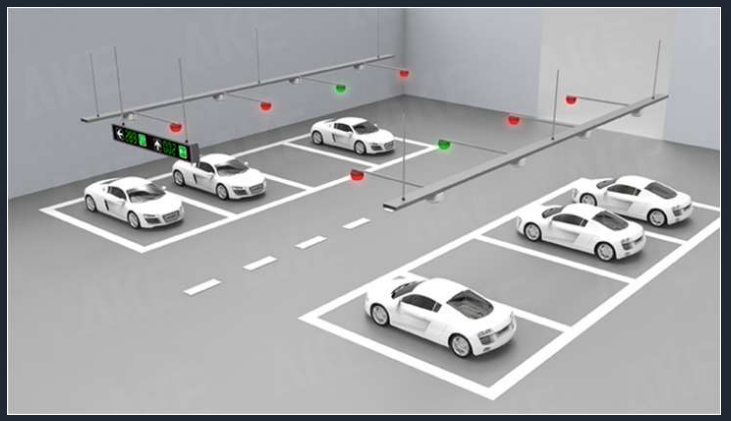
Problem definition

- Why is it important?
  - Average search time for parking spot == **7.8 min.**
  - **Traffic!!!**

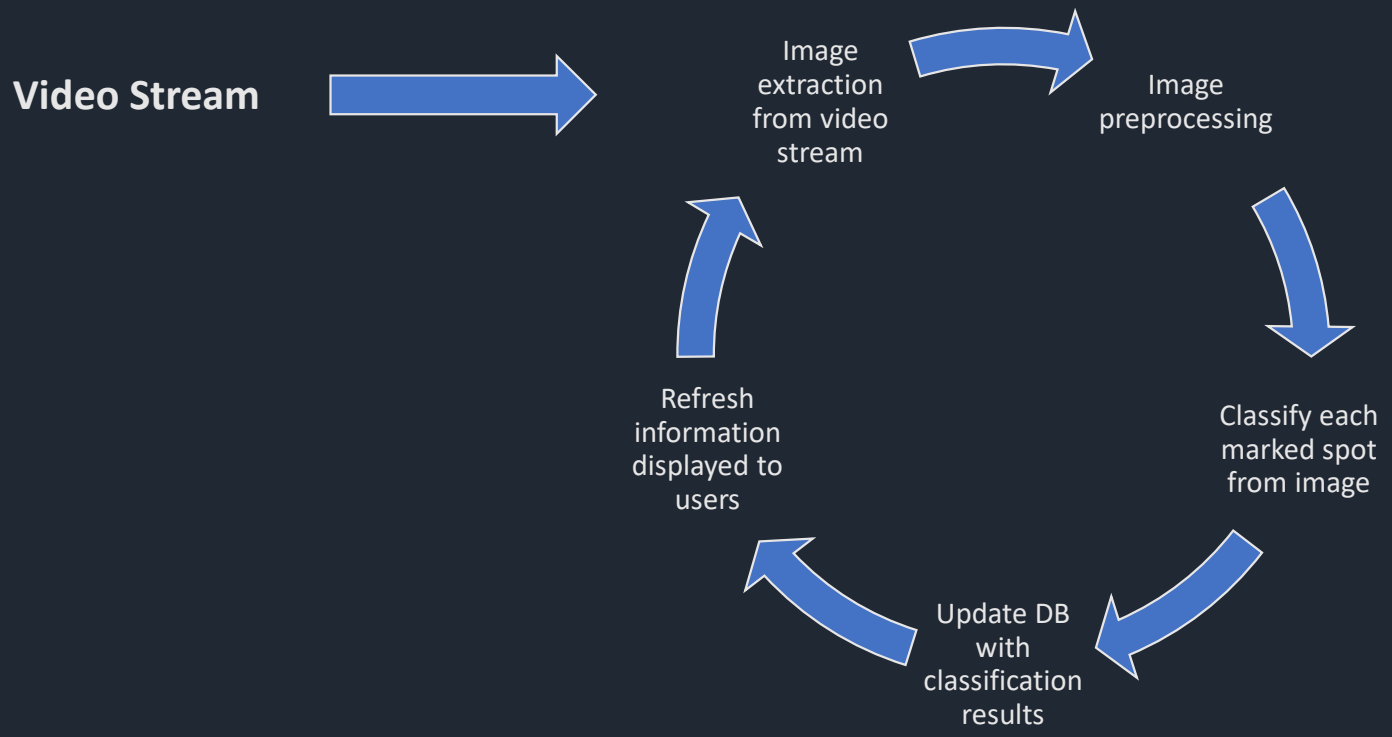
- Existing solutions?
  - Counter-based
  - Sensor-based
  - Image recognition - based



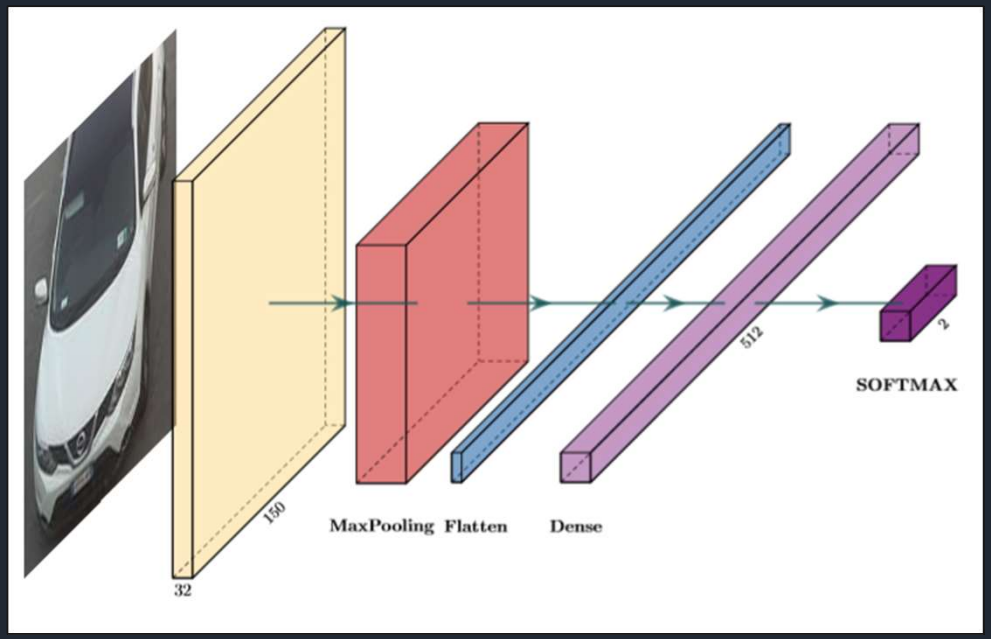
Related work

- *Acharya, D., Yan, W., and Khoshelham, K. (2018).* **Real-time image-based parking occupancy detection using deep learning**. [ref]
  - Pre-trained CNN to extract features → Support Vector Machine classifier
- *Tschentscher, M. and Neuhausen, M. (2012).* **Videobased parking space detection**. [ref]
  - HSV color histogram → Support Vector Machine classifier
- *Števanák, R., Matejov, A., Šuppa, M., and Jariabka, O. (2017).* **Pkspace: An open-source solution for parking space occupancy detection**. [ref]
  - Multi-Layer Perceptron classifier

Proposed approach



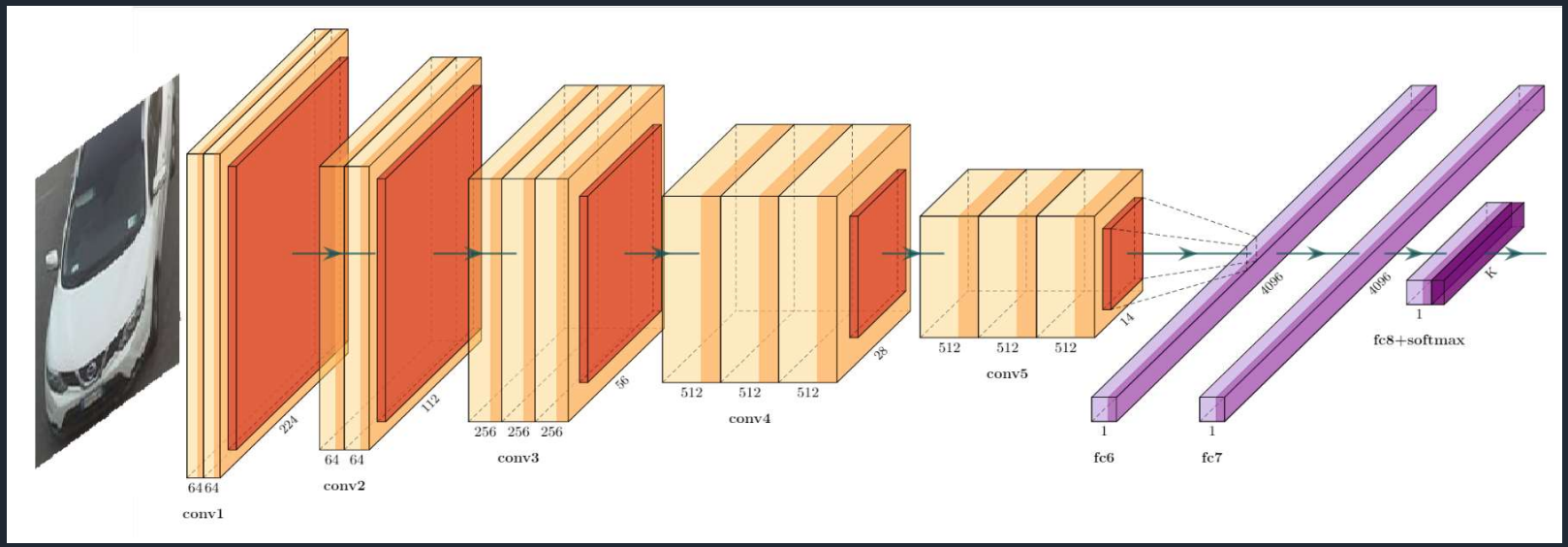
Methodology



Custom CNN

- Adam gradient-based optimizer
- Sparse-categorical cross-entropy loss function

Methodology

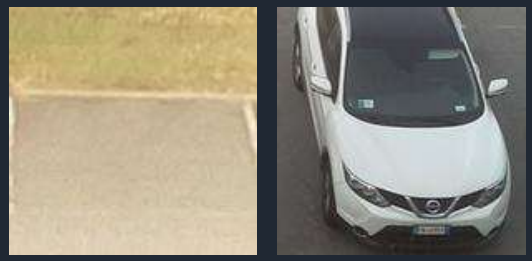


VGG-16

- Stochastic gradient descent optimizer
- Sparse-categorical cross-entropy loss function

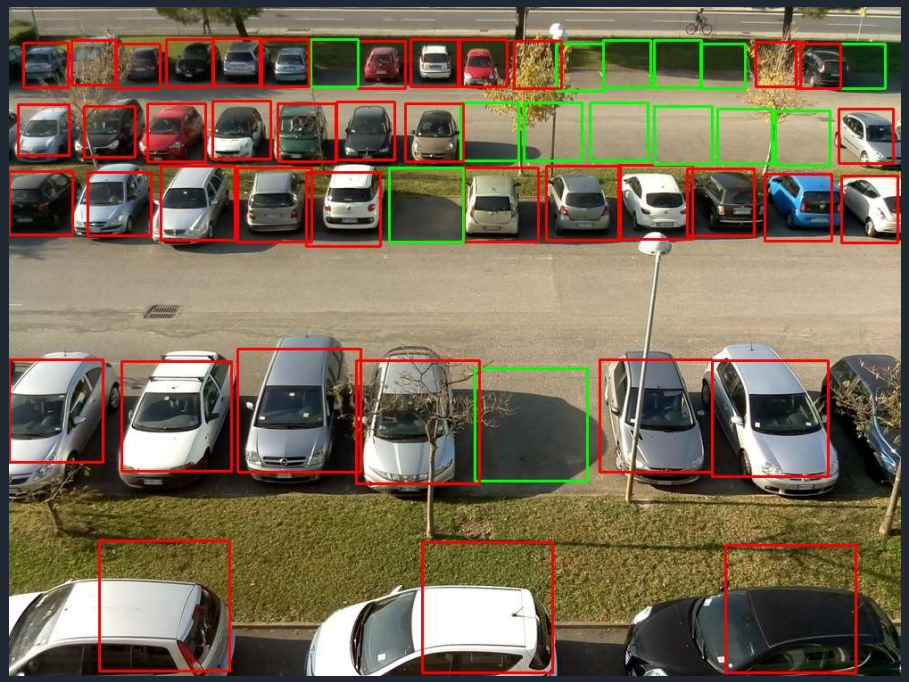
Dataset & results

CNRPark+EXT [ref]



150x150 px patches, free and occupied

8000 images



Dataset & results

- Validation split for training dataset: **33% (2666 images)**
- Tested on **920 images**

Model	Training Accuracy	Validation Accuracy
Custom CNN model	0.99	0.96
VGG-16 model	0.86	0.79

Experimental results

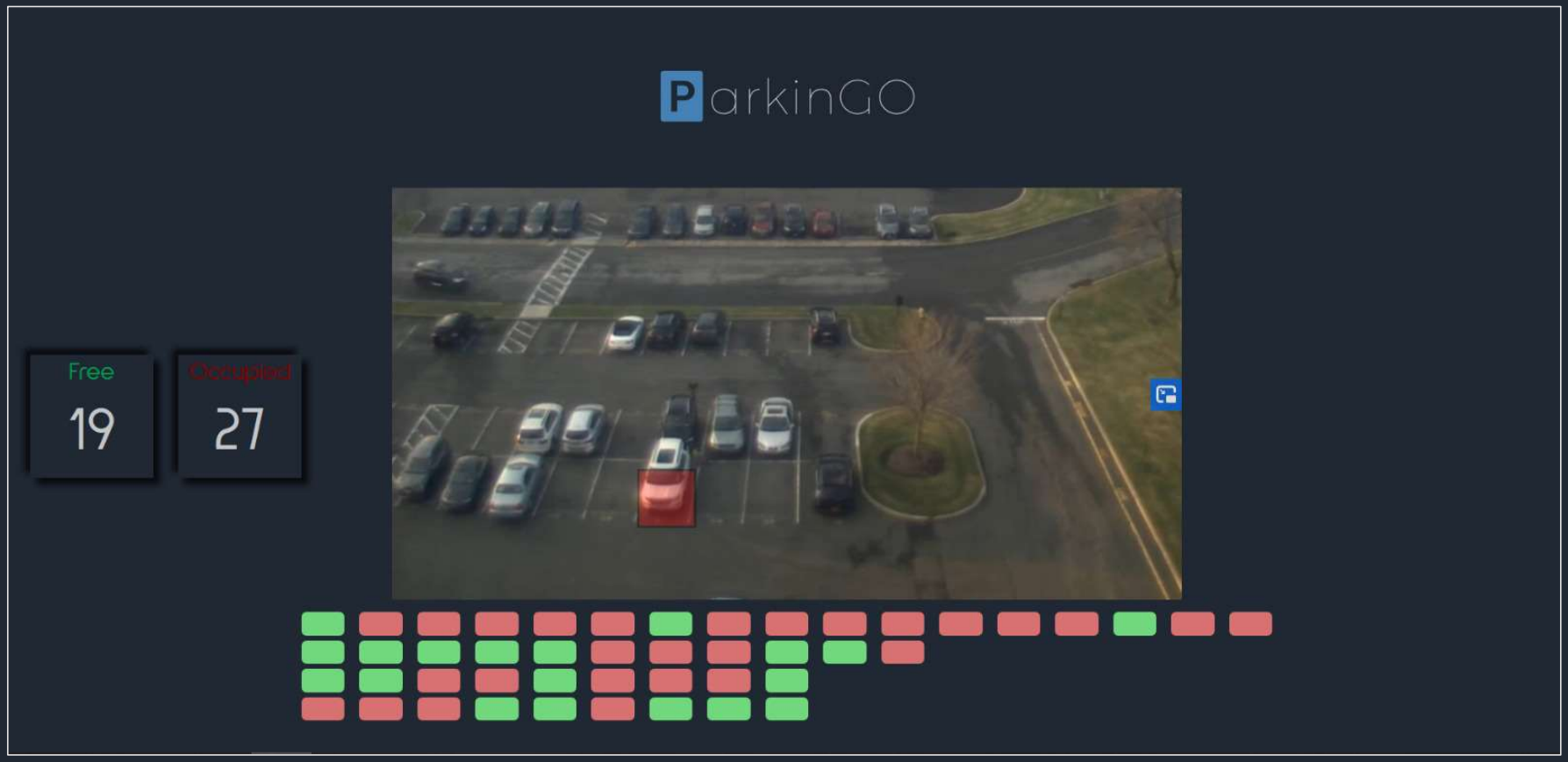
- Tested on **920 images**

Model	Accuracy	Busy		Free	
		Precision	Recall	Precision	Recall
Custom CNN model	0.86	1	0.77	0.74	1
VGG-16 model	0.79	0.87	0.75	0.70	0.85
Custom CNN model (+improvements)	0.98	0.99	0.98	0.97	0.99

Used Tools

Pillow

Demo



Faced challenges

Finding the right information

Choosing the fittest approach for our problem

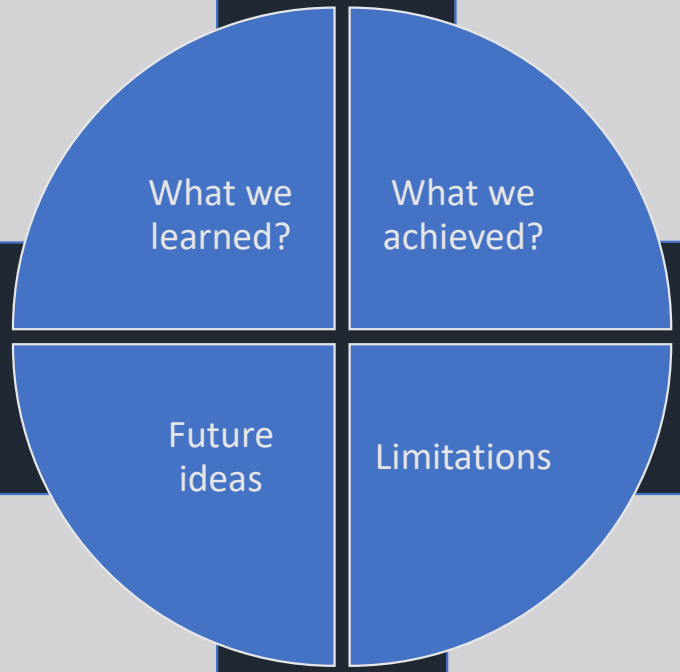
Understanding the framework

Hardware limitation

Finding open source video stream for demo

Algorithm improvement

Conclusion & Future improvements



- Basics of image processing
- Tensorlow & Keras
- Writing a research paper

- Proof of Concept application
- High accuracy on slots classification
- Comparable results with alternative solutions
- Lightweight application

- Automatic spots detection
- Extending the training dataset for other weather & light conditions
- Finetuning of the model & image preprocessing

- Accuracy based on image quality
- Spots are manually marked
- Limited by weather & light conditions

Thank you!