Parking slot Detection and Tracking: A low cost approach

André Bargas
Miguel Pimentel

Tópicos Avançados de Engenharia de Software
Bacharelado em Engenharia de Software
Universidade de Brasília (UnB)

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Introduction - IoT

The Internet of Things (IoT), also called the Internet of Everything or the Industrial Internet, is a new technology paradigm envisioned as a global network of machines and devices capable of interacting with each other. [1]

Introduction - Smart Cities

- IOT is also one of the basis to build a "smart cities".
- This term makes reference to cities that use technology in a extreme level in a way to help better management of resources and life quality for the population
- Some of the fields that Smart Cities focus on working on are:
  - Data gathering
  - Water and electricity distribution systems
  - Crime detection
  - Social services
  - Sustainability
  - Transportation

Introduction - Parking Lot and Traffic Issues

- Parking is one of the main problems in big cities urban mobility
- What may cause those problems :
  - Insufficient parking spaces
  - Non effective use of parking spaces
  - Drivers looking for a parking available space for huge periods of time
  - Bad signalization for allowed or not parking spaces
  - Bad use of priority parking spaces
  - People using cars to go to over crowded places

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CRIPS-DM

The Cross Industry Standard Process for Data Mining (CRISP-DM) is a methodology developed for data mining. Since its conception in 2006, the methodology has become increasingly used by data mining specialists to solve problems of this nature [2].

CRIPS-DM Phases

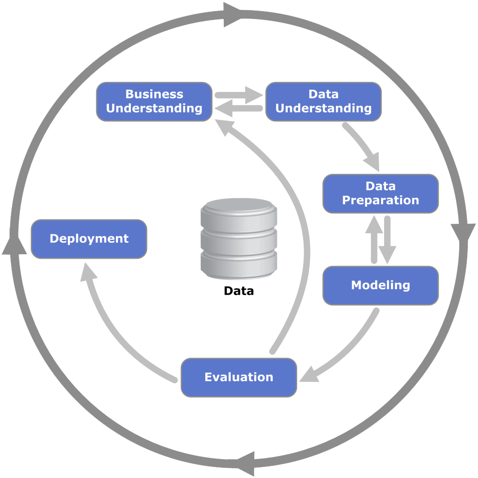

Figure: CRISP-DM Methodology Cycle - Source: Colin Shearer

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Dataset: PKLOT Dataset

- The PKLot dataset contains 12,417 images of parking lots and 695,899 images of parking spaces segmented from them, which were manually checked and labeled. All images were acquired at the parking lots of the Federal University of Parana (UFPR) and the Pontifical Catholic University of Parana (PUCPR)
- The dataset is currently available for research purposes upon request. To gain a better insight into this dataset we have evaluated two textural descriptors, Local Binary Patterns and Local Phase Quantization, with a Support Vector Machine classifier to detect parking lot vacancy.

Dataset: PKLOT Dataset

- This process was defined to be executed with a 5-min time-lapse interval for a period of more than 30 days by means of a low cost full high definition camera.
- The main goal was to obtain images under different weather conditions (overcast, sunny, and rainy periods) by registering at each 5 min the environment changes.
- The dataset is currently available for research purposes upon request. To gain a better insight into this dataset we have evaluated two textural descriptors, Local Binary Patterns and Local Phase Quantization, with a Support Vector Machine classifier to detect parking lot vacancy.
- They were organized into three subsets named UFPR04, UFPR05 and PUCPR. The first two contain images of different views of the same parking lot captured from the 4th and 5th floors of the UFPR building. The last dataset contains images captured from the 10th floor of the administration building of the PUCPR.

Dataset

- For each parking lot image was created an Extensible Markup Language (XML) file containing the position and situation (vacant or occupied) of each parking space.
- Such a tool allows the visualization of each image and the definition of the limits of each parking space (represented by points of a polygon), as well as the situation (vacant or occupied).

Dataset: PKLOT Dataset

- The individual parking spaces were extracted from each parking lot image using the information available in the corresponding XML file.

PK dataset example

(a) (b) (c)

Figure: PK dataset example - Source: Paulo RL De Almeida, 2015

Dataset: PKLOT Dataset

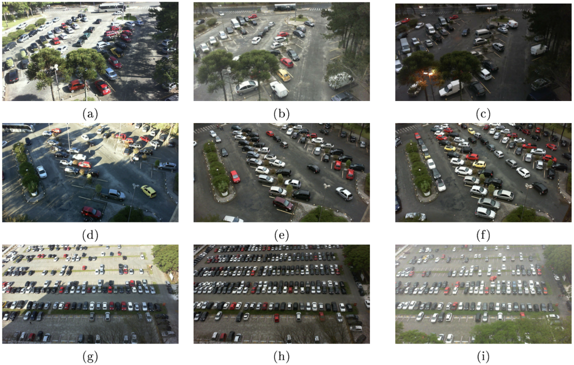

Figure: PK dataset distribution - Source: Paulo RL De Almeida, 2015

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Data Preparation

Figure: Manipulated Imagem - Source: Bargas, A and Pimentel, M.

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Modeling

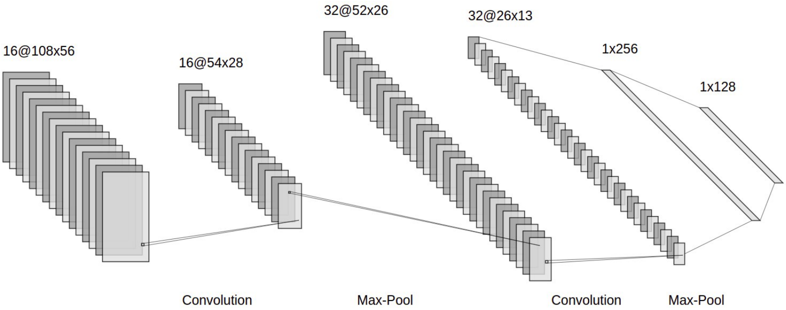

Figure: Model Architecture - Source: Bargas, A and Pimentel, M.

Modeling

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 108, 56, 16)	448
max_pooling2d (MaxPooling2D)	(None, 54, 28, 16)	0
conv2d_1 (Conv2D)	(None, 52, 26, 32)	4640
max_pooling2d_1 (MaxPooling2	(None, 26, 13, 32)	0
flatten (Flatten)	(None, 10816)	0
dense (Dense)	(None, 128)	1384576
dropout (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 1)	129
activation (Activation)	(None, 1)	0

Total params: 1,389,793
Trainable params: 1,389,793
Non-trainable params: 0

Figure: Model Summary - Source: Bargas, A and Pimentel, M.

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Results

- Accuracy: 0.9985
- Data Loss: 0.0082

* With validation data

ROC Curve

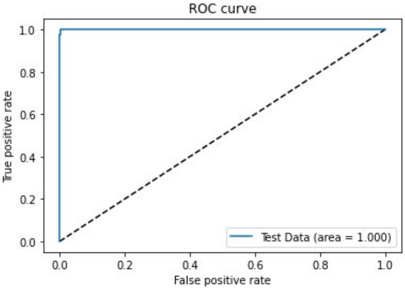

Figure: ROC Curve - Source: Bargas, A. Pimentel, M.

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Results

- ROC Curve with high rate
- Data Addictive behaviour
- Apply in different dataset

References I

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