Ground Truth Coordinates for Automatic License Plate Recognition

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Introduction

- What is Automatic License Plate Recognition (ALPR)?
  - Technology that identifies and reads vehicle license plates using digital image processing
- Presentation focus:
  - Focusing on ground truth coordinates in ALPR, explaining their role in training & refining accuracy of recognition algorithms
- Importance of accurate data:
  - Accurate data annotation is crucial for reliability of ALPR systems, impacting applications in traffic surveillance, law enforcement & smart city projects
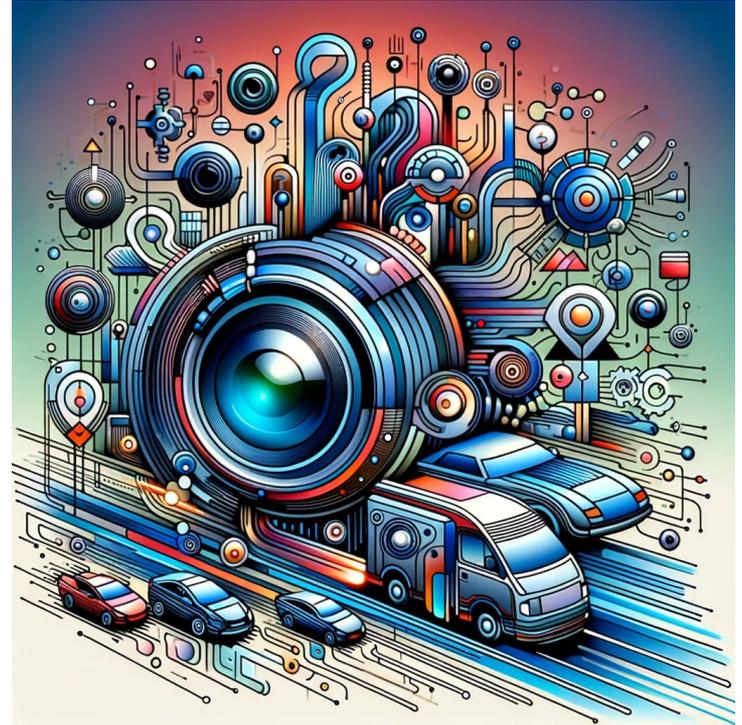
The Automatic License Plate Recognition (ALPR) Data Set

- The ALPR data set under examination was curated from CCTV footage
- Source Reference Circuits (SRC) video sequences were recorded at AGH University of Krakow, Lesser Poland, focussing on high-traffic parking areas during peak hours
- The compiled data set encompasses approximately 15,500 frames in total

Technical Term Definitions
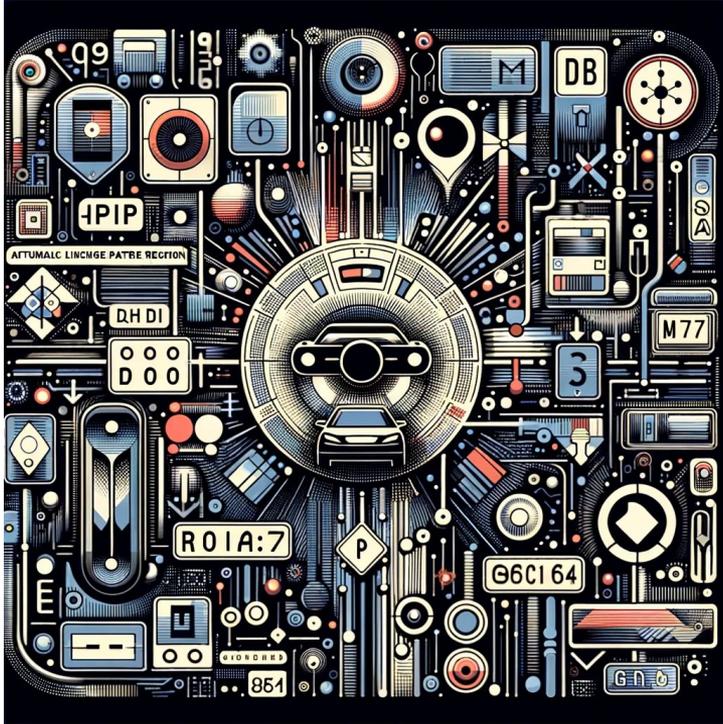
- Ground truth annotation:
  - Process of manually labeling image data with correct information, such as exact location & characters of license plates in image
  - Ensures high accuracy in training machine learning models for ALPR, providing reliable benchmark for algorithm performance
- Coordinate formatting in ALPR:
  - Refers to specific way in which position & dimensions of license plate are represented in dataset, using set of numerical values
  - Critical for accurately locating & recognizing license plates within varied images, crucial for effective ALPR
- Data annotation naming convention:
  - Systematic method used for naming annotated files in dataset, including details like image source, date & specific annotations
  - Facilitates organized data management & retrieval, essential for large datasets used in ALPR research and application

Ground Truth Annotation

- Ground truth coordinates have been prepared to facilitate the assessment of automatic license plate recognition
- For each video in the data set, a corresponding text file containing ground-truth information has been created
- This text file adheres to the following naming convention: `video_name_anno.txt`
- Each of these files lists the coordinates specifying the location of the license plate in individual frames

Ground Truth Annotation: demo

Coordinate Formatting

- Within each ground truth file, coordinates are formatted as follows:
  `image_number.jpg,X1,Y1,X2,Y2,X3,Y3,X4,Y4`
- An example line could look like:
  `1.jpg 511 137 582 136 582 154 512 154`

Coordinate Significance

The coordinates $(X1, Y1)$, $(X2, Y2)$, $(X3, Y3)$, $(X4, Y4)$ designate the following points on the license plate:

- $(X1, Y1)$: Top-left corner of the licence plate
- $(X2, Y2)$: Top-right corner of the licence plate
- $(X3, Y3)$: Bottom-right corner of the licence plate
- $(X4, Y4)$: Bottom-left corner of the licence plate

Coordinate Significance

The coordinates $(X1, Y1)$, $(X2, Y2)$, $(X3, Y3)$, $(X4, Y4)$ designate the following points on the license plate:

Special Cases

- In cases where the licence plate is fully occluded, all coordinates are annotated as zero
- For example:

  `50.jpg 0 0 0 0 0 0 0 0`
- For partially occluded license plates, only the visible portions are annotated in the ground truth file

Data Availability

- The entire data set can be accessed in the https://qoe.agh.edu.pl/parking-database/ link
- A representative example SRC frame from the data set, intended for e.g. video quality assessment in license plate recognition, is illustrated in figure

Real-World Applications of ALPR Dataset

- Traffic efficiency and safety:
  - ALPR technology significantly contributes to traffic flow optimization & congestion management on highways & urban roads
  - It enhances road safety by aiding in quick identification of vehicles involved in traffic violations or accidents
- Law enforcement & security measures:
  - Crucial in identifying & tracking stolen or suspect vehicles, thereby assisting in criminal investigations & improving overall public safety
  - Employed at border crossings and checkpoints to automate & secure vehicle clearance processes
- Smart city & infrastructure development:
  - Integral to development of smart parking solutions, reducing time & resources spent in locating parking spaces in busy urban areas
  - Facilitates automated toll collection & aids in implementation of congestion pricing models to manage city traffic more effectively
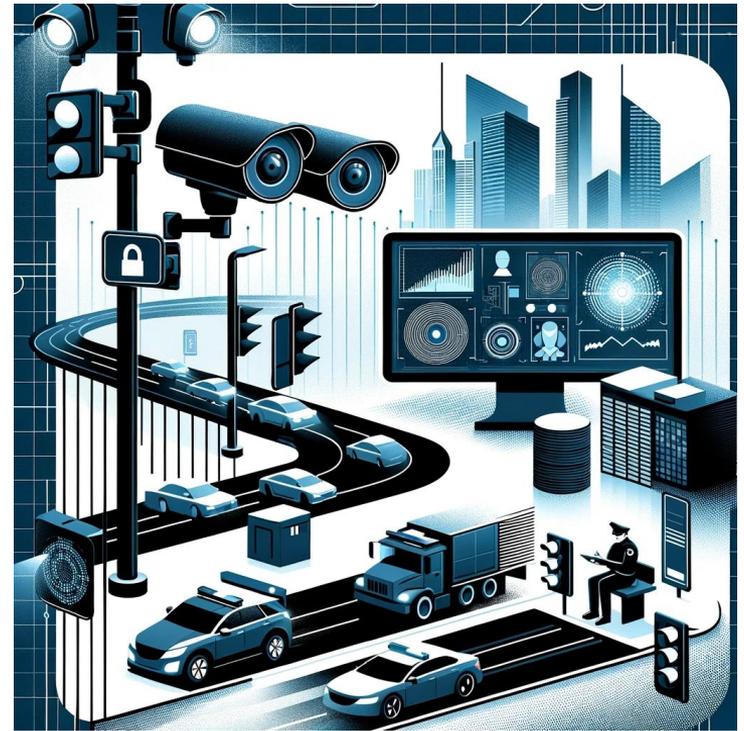
Conclusion and Future Directions

- ALPR Dataset's Broad Impact:
  - 15,500+ frames from AGH University CCTV, meticulously annotated
  - Dataset's vital role in streamlining traffic flow, aiding law enforcement & supporting smart city initiatives
- Challenges & Adaptive Strategies:
  - Addressing occlusions & variable lighting
  - Need for adaptable solutions in diverse urban & environmental settings
- Vision for ALPR Technology:
  - Expanding capabilities through machine learning & neural network advancements
  - Broadening scope to include predictive traffic analytics & autonomous vehicle support

Publication

Leszczuk, Mikołaj; Janowski, Lucjan; Nawała, Jakub; Zhu, Jingwen; Wang, Yuding; Boev, Atanas, "Objective Video Quality Assessment and Ground Truth Coordinates for Automatic License Plate Recognition", Journal Article In: Electronics, vol. 12, no. 23, pp. 4721, 2023