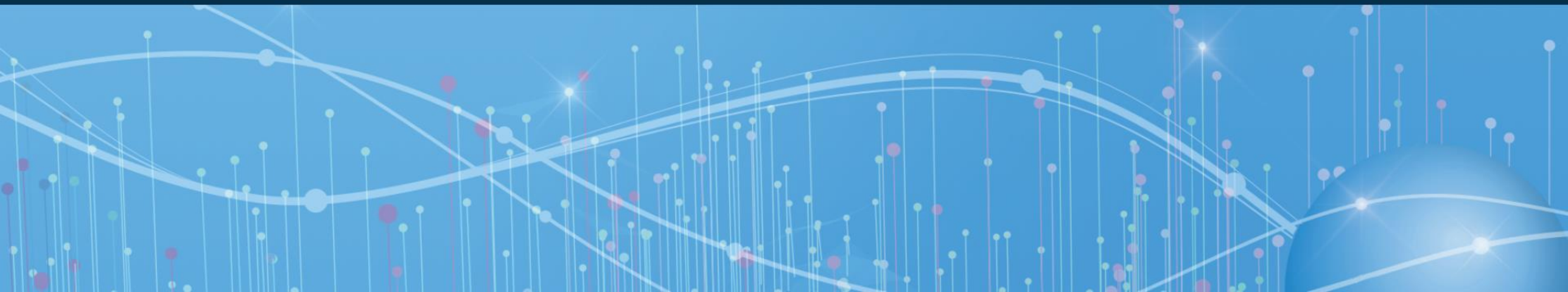
#SASGF

VIRTUAL

SAS® GLOBAL FORUM 2021



Automated Vehicle Odometer Reading Using SAS® for AI and Computer Vision

Tyler Rosacker, Angela Wu (State Farm)

Kedar Prabhudesai, Hardi Desai, Neela Vengateshwaran, Varunraj Valsaraj (SAS Institute Inc.)

Agenda

- Research Goal
- Odometer Detection Model
- Digit Detection Model
- Combined Pipeline
- Potential Enhancements

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

Research Goal

Build a pipeline that can read a vehicle odometer based upon just the dashboard photo

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

Challenges

- Localizing Odometer region
  - Dashboards have a lot of digits on them other than odometers
- Size of Odometer region
  - Area covered is less than 0.01 % of total area
- Mechanical vs. Digital Odometer
- Digit Recognition
  - Different vehicles have different digits formats
  - Decimal is set differently in mechanical and digital odometer
  - Confusion in digits: (1,7), (3,8) and (0,8)

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

General Pipeline

Raw Image

↓

Resize The Image

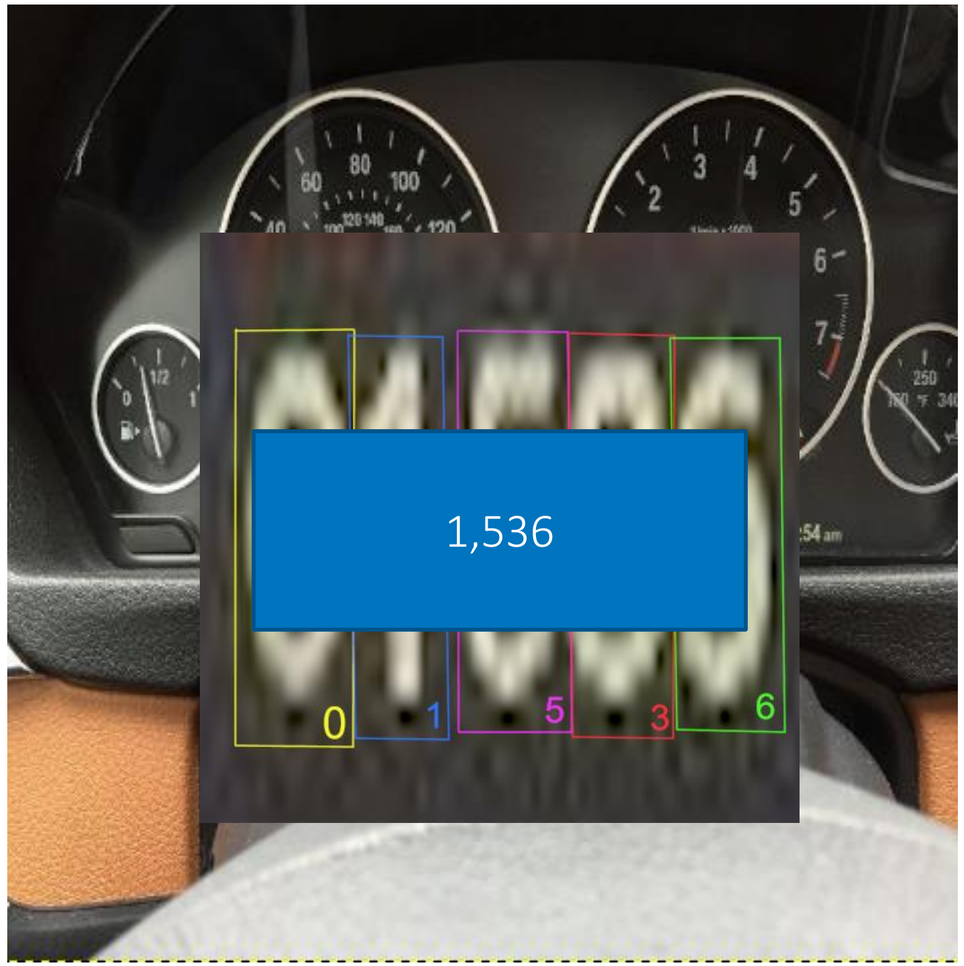
↓

Detect The Odometer

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

General Pipeline

- Raw Image
- Resize The Image
- Detect The Odometer
- Crop the Image
- Detect The Digits
- Convert Digits to “Reading”



SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

Odometer Detection

Task

- Spot the odometer
- Give a confidence on its detection

Model Building

- Random grid search over 3-week period
- Total of ~2500 models built

Champion Performance

- Percent of Odometers Detected: 88.3%
- False Positive Detections: 13.3%

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

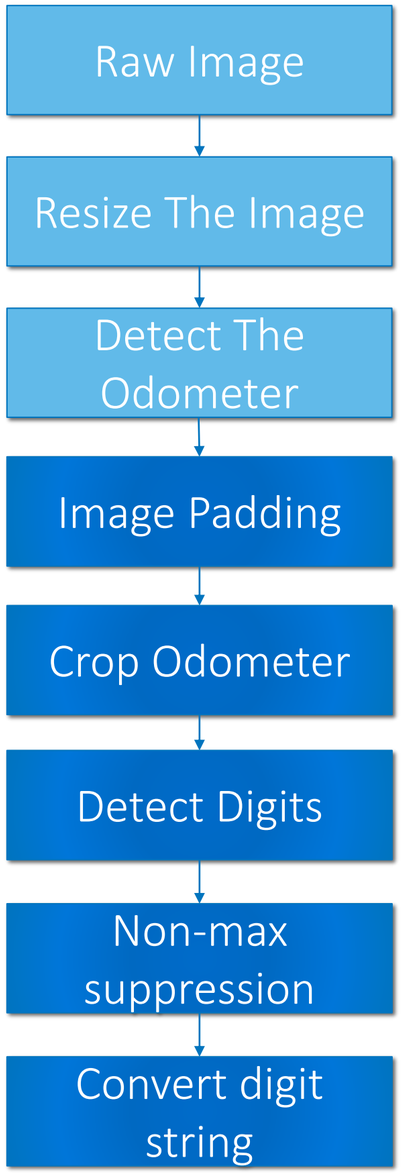
Odometer Detection - Demo

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

Odometer Detection - Demo

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

General Pipeline

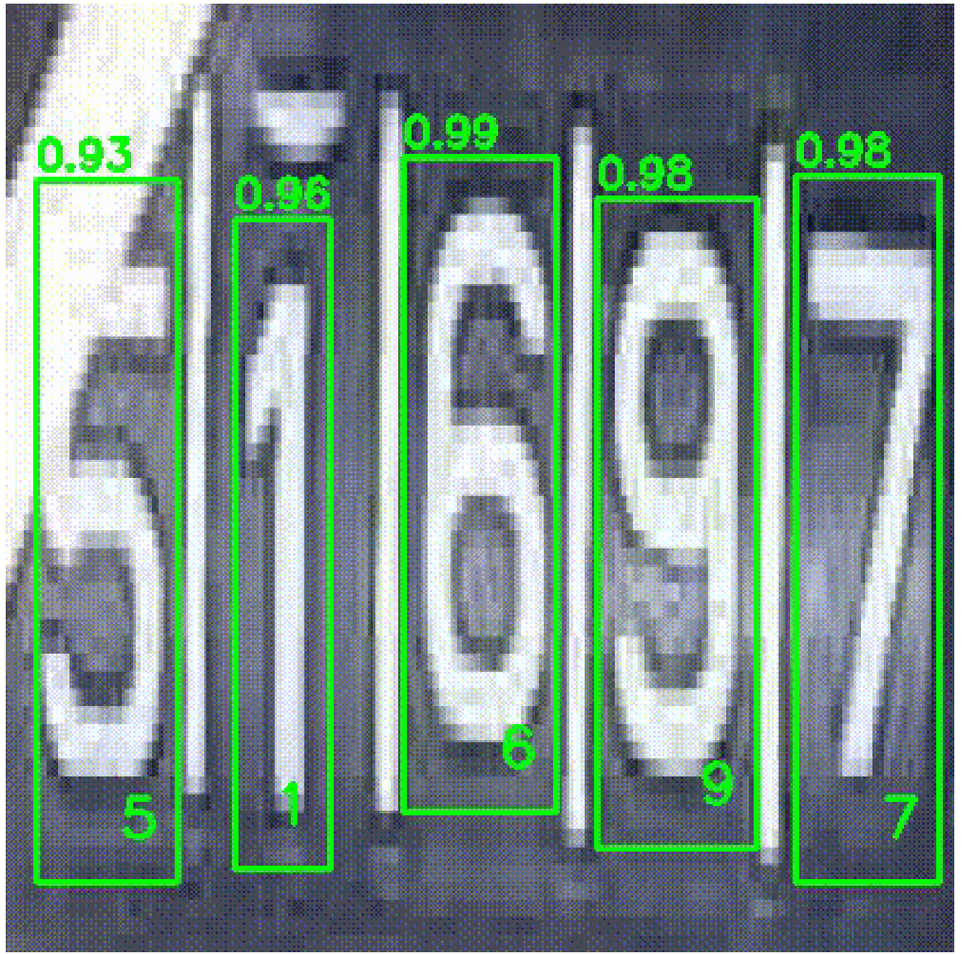


33,000 SVHN Images + 2,700 State Farm Images

StateFarm

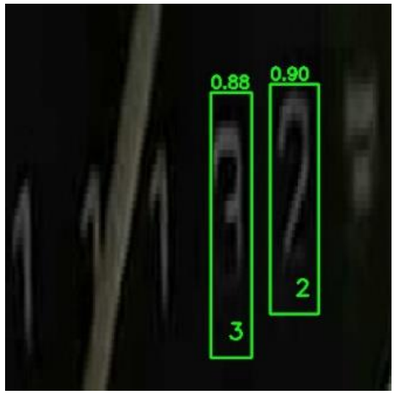
SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

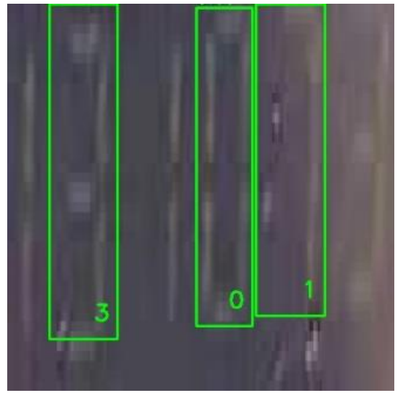
Digit Detection - Demo

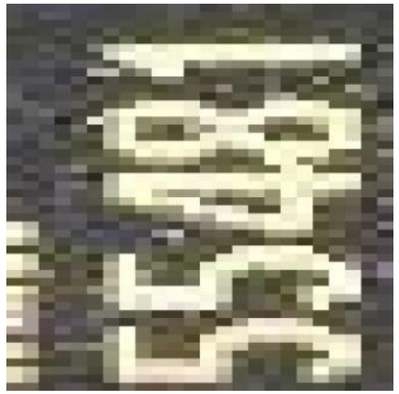


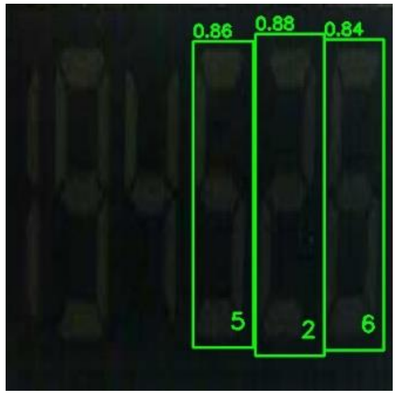
SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

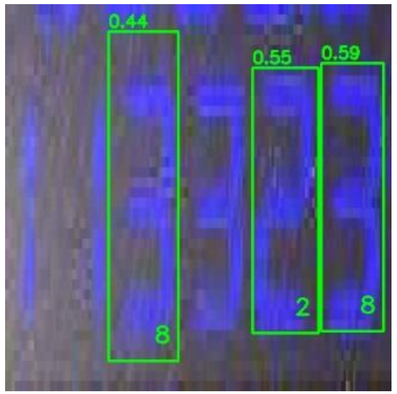
Some bad performers

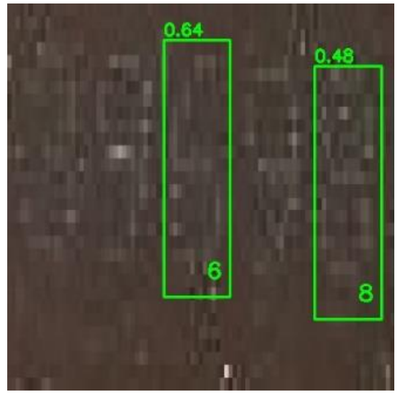


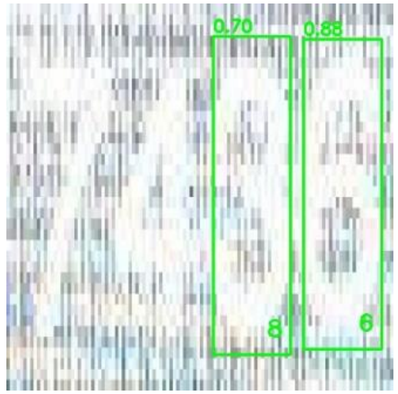


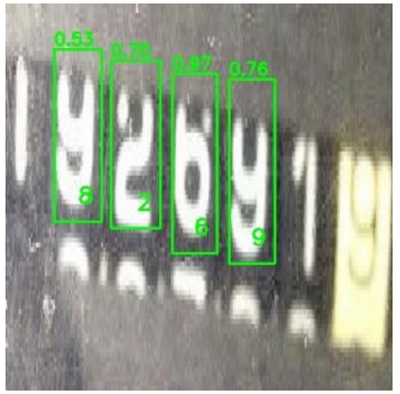


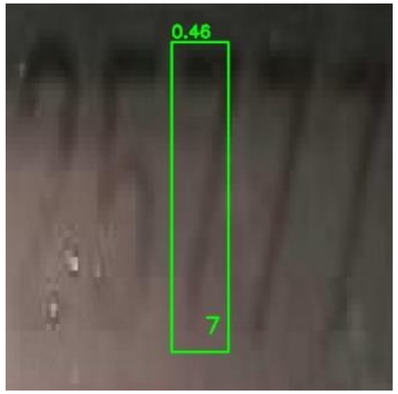






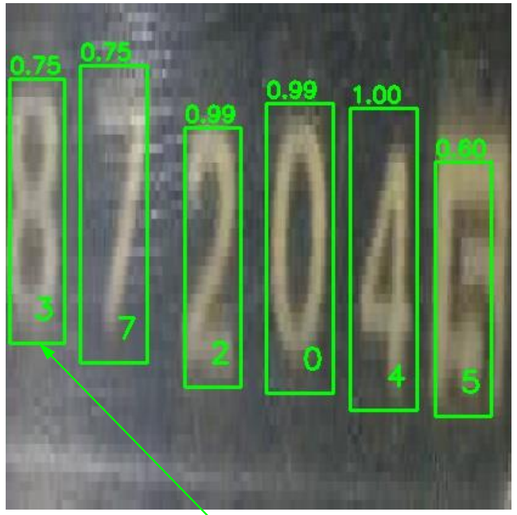




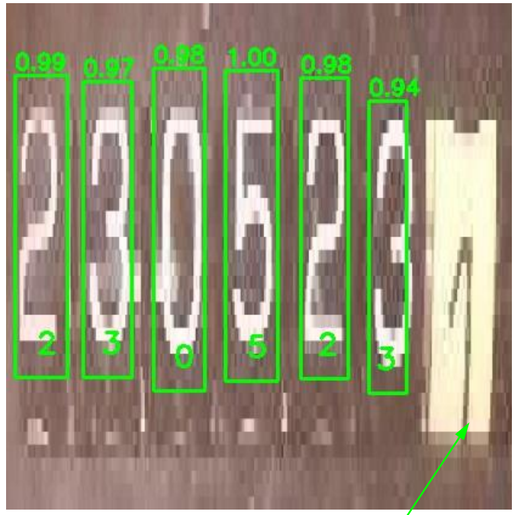


SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

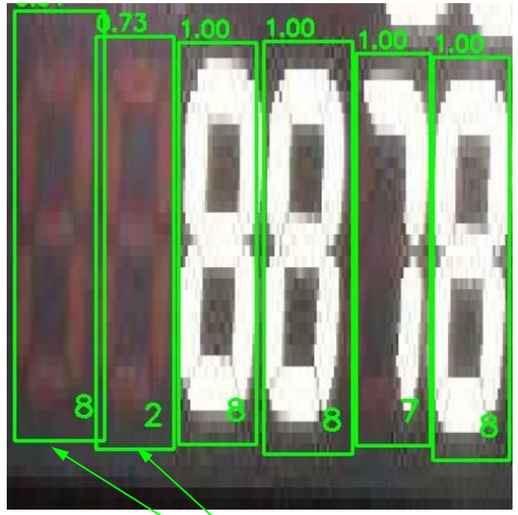
Evaluation using Digit Error Rate (DER)



substitution



deletion



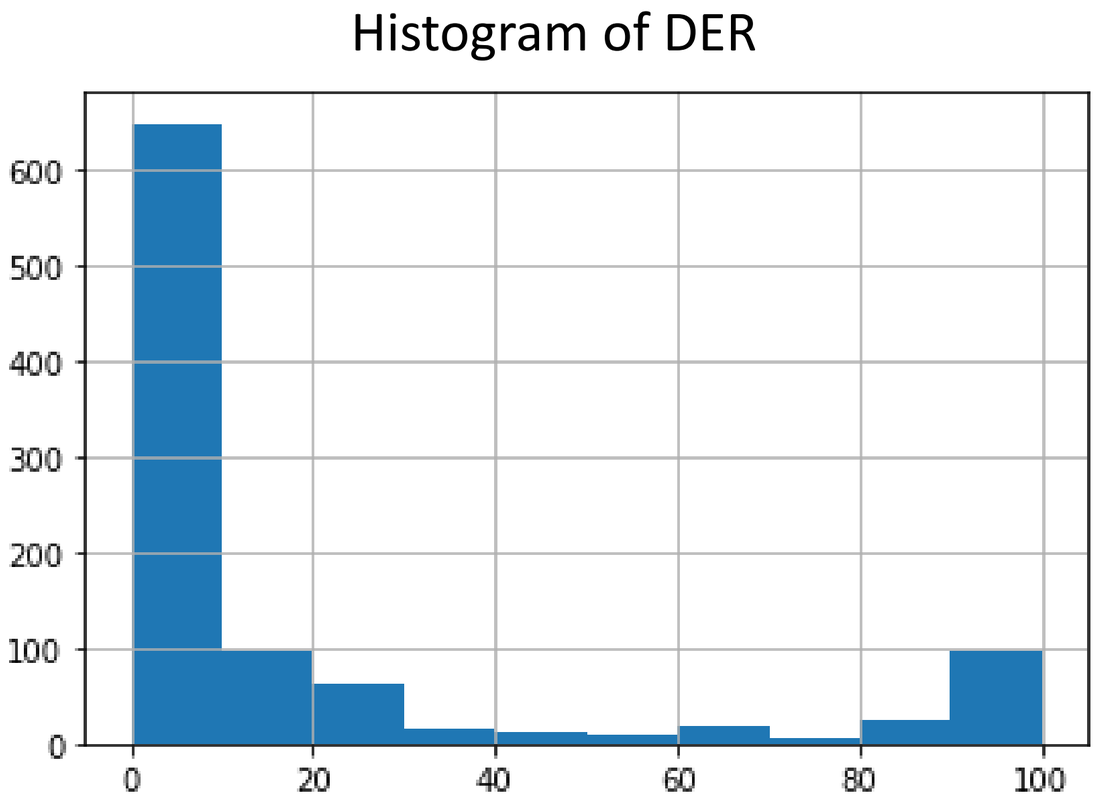
insertion

$$DER = \left[\frac{N_{subs}+N_{dels}+N_{ins}}{N_{total}}\right] \times 100$$

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

Combined Pipeline Results

Evaluated on 989 holdout images



- 648 images (65.5%) had 0% DER
- 833 images (84.2%) had DER <= 40%
- 380 images (38.42%) had DER > 40%
- Total DER for 5,492 digits = 17.53%

$$= \frac{N_{subs}\ (248)\ +\ N_{dels}\ (600)\ +\ N_{ins}(115)}{N_{total}\ (5{,}492)}$$

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

Summary

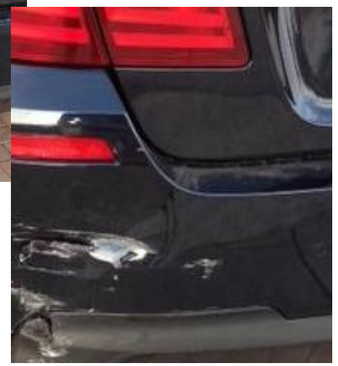
- Our system automatically extracts odometer readings from vehicle dashboard images using **two deep learning models** – one to isolate the odometer and another to recognize digits
- The odometer detection model has an **accuracy of 88.3%** with a **false positive rate of 13.3%**
- The digit recognition model has an overall **digit error rate of 17.53%**
- Please refer to our paper for additional details about the methodology along with results

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

Other Applications using Computer Vision

Case #1: Identification of Shared Ride Vehicles

Case #2: Identification of Reappearing Claims



Case #3: Identification of Previous Damage

Case #4: Identification of the Damaged Car Part

#SASGF

SAS® GLOBAL FORUM 2021

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration. Other brand and product names are trademarks of their respective companies.

#SASGF

SAS® GLOBAL FORUM 2021

sasglobalforum.com