Automatic Number Plate Recognition using Super Resolution

Final Year Project

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Introduction

- "Automatic Number Plate Recognition" can be used to monitor the vehicles'.
- Features include accuracy and efficient use of technology
- ANPR camera takes an image of a vehicle number plate; passes to a reader, which reads the letters and characters using Optical Character Recognition (OCR) software.
- An image of the view of the number plate and/or overview camera is then saved and checked against the database.
- Language used is Python
- Main libraries used: OpenCV, EasyOCR, Matplotlib, PyTorch and Numpy

Motivation

- Research in ANPR stems from a general interest in criminology and surveillance technologies.
- As compared to CCTV, little academic attention has been awarded to CCTV application systems such as ANPR for policing, crime prevention and civil liberties
- Need for embedding ANPR technology into mainstream policing for intelligence development

Literature Survey

- With the aim of providing an AI-based approach of solving the problem statement, we went through the following Literatures in order to learn more about the Image classification and Natural Language Processing domains of AI
- ICT ,IEEE Conference paper presented by authors of Pondicherry Engineering College.
- Learn about Object Detection with Computer Vision

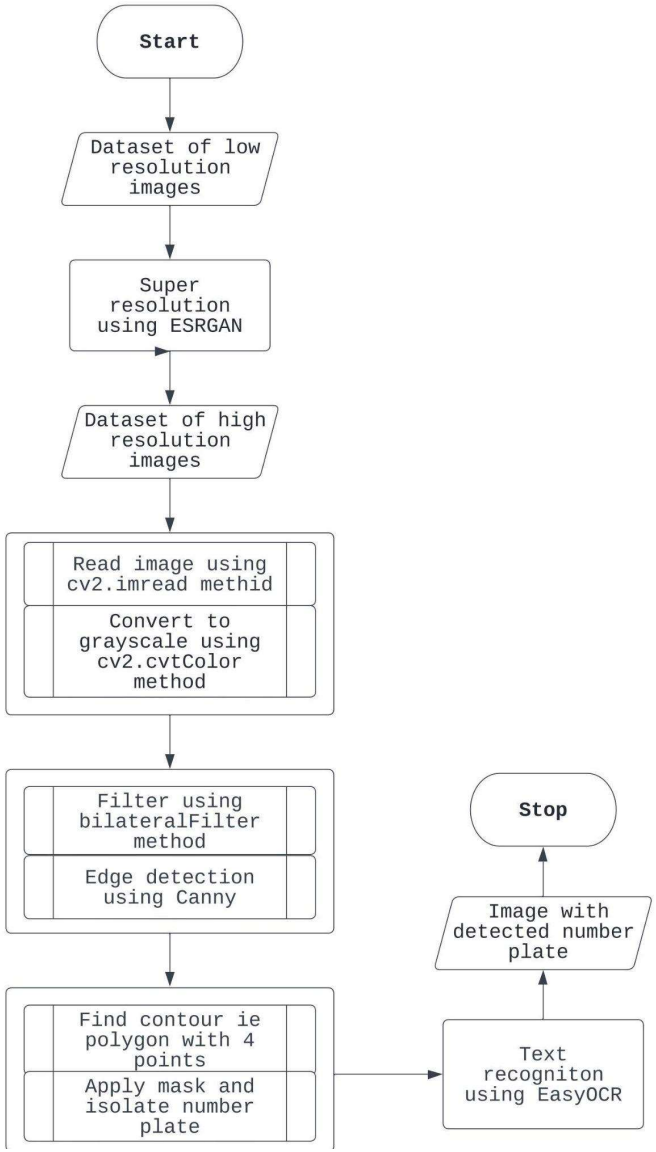
Literature Survey

- **Kranthi,K.Pranthi** proposed that Automatic Number Plate Recognition is a method that catches the vehicle image and confirmed their license number. ANPR can be used in various manners by using to identify stolen vehicle.
- **Abd Kadir Mahamad** explained automatic number plate inspection of letters using image processing.
- **Kuldeepak** introduced that high level of precision is required when streets are occupied and number of vehicles pass by.

Problem Statement

- Many low resolution images of vehicles are captured by CCTV cameras on highways.
- Blurry images of vehicles involved in accidents might also be reported to the police.
- Identification of number plates of such vehicles will enhance security.
- Project aims to solve the problem of recognition of number plates in low resolution images.

Solution Approach



The flowchart represents steps we have opted in our project:

1. Import libraries
2. Enhance resolution using ESRGAN
3. Read images and convert to grayscale
4. Apply filter and find edges for localisation
5. Find contours and apply mask
6. Text recognition using EasyOCR

Solution Approach

Algorithm

Step 1: Import libraries

Main libraries include OpenCV, EasyOCR, Matplotlib, PyTorch and Numpy

```
In [ ]: !pip install easyocr
        !pip install imutils
```

```
In [1]: import cv2
        from matplotlib import pyplot as plt
        import numpy as np
        import imutils
        import easyocr
```

```
In [2]: import os.path as osp
        import glob
        import torch
        import RRDBNet_arch as arch
```

Solution Approach

Step 2: Super resolution using ESRGAN

- ESRGAN stands for Enhanced Super Resolution Generative Adversarial Network
- It is an open source pre trained super resolution model developed by Xinntow
- Two neural networks are used: Generator and Discriminator

Solution Approach

Step 3: Read images and convert to grayscale

- OpenCV method imread() to read image file
- OpenCV method cvtColor() to convert BGR image to grayscale
- Matplotlib is used to display image
- We apply cvtColor() again since Matplotlib expects a BGR input

```
In [79]: img = cv2.imread('result/image4_rlt.png')
         gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
         plt.imshow(cv2.cvtColor(gray, cv2.COLOR_BGR2RGB))
```

```
Out[79]: <matplotlib.image.AxesImage at 0x216267861f0>
```

Solution Approach

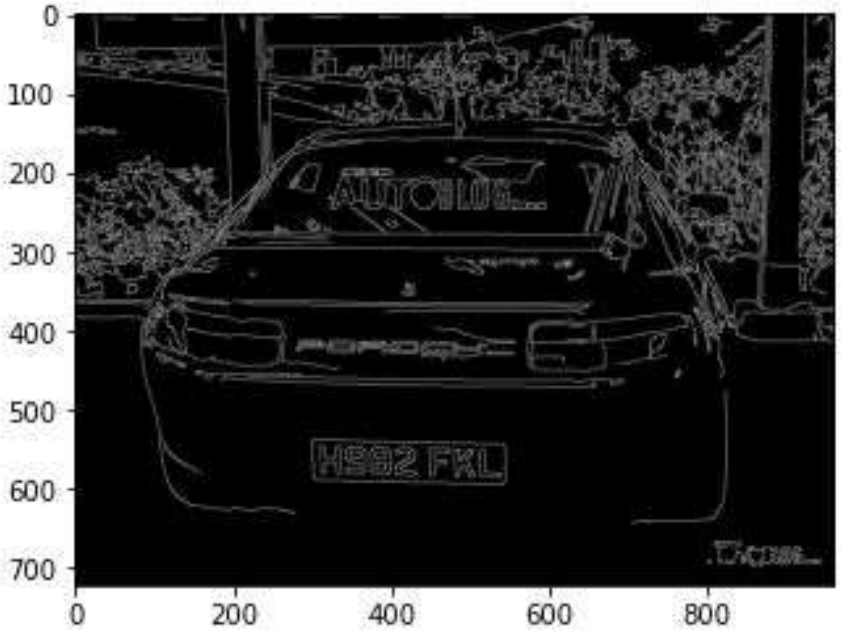
Step 4: Apply filter and find edges for localisation.

- Filter image to reduce noise using bilateralFilter() method
- In this method we describe parameters for how intense noise reduction should be
- We use operator known as Canny edge detector
- Matplotlib is used to display image

Apply filter and find edges for localization

In [80]:
```
bfilter = cv2.bilateralFilter(gray, 11, 17, 17) #Noise reduction
edged = cv2.Canny(bfilter, 30, 200) #Edge detection
plt.imshow(cv2.cvtColor(edged, cv2.COLOR_BGR2RGB))
```

Out[80]:
```
<matplotlib.image.AxesImage at 0x21626b76520>
```



Solution Approach

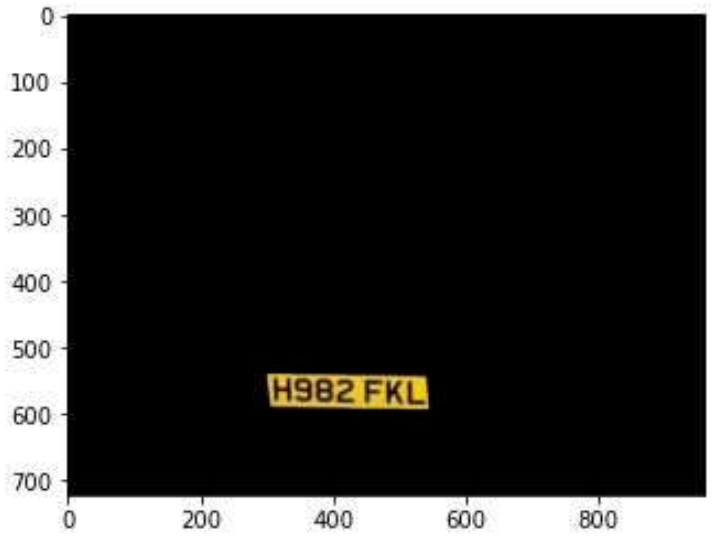
Step 5: Find contours and apply mask

- Finding contours means finding polygons in the image
- We want contours with 4 points
- Sort top 10 contours
- Check among all if they represent rectangle
- Higher the parameters, rougher the contour
- Apply mask to isolate number plate
- Crop number plate for easier processing

```
In [83]: location
Out[83]: array([[[300, 540]],

                [[306, 589]],

                [[543, 592]],

                [[538, 543]]], dtype=int32)
```

calculating location of number plate

```
In [85]: plt.imshow(cv2.cvtColor(new_image, cv2.COLOR_BGR2RGB))
Out[85]: <matplotlib.image.AxesImage at 0x2162725b520>
```



isolation of number plate

Solution Approach

Step 6: Text recognition

- EasyOCR identifies relatively similar text from image

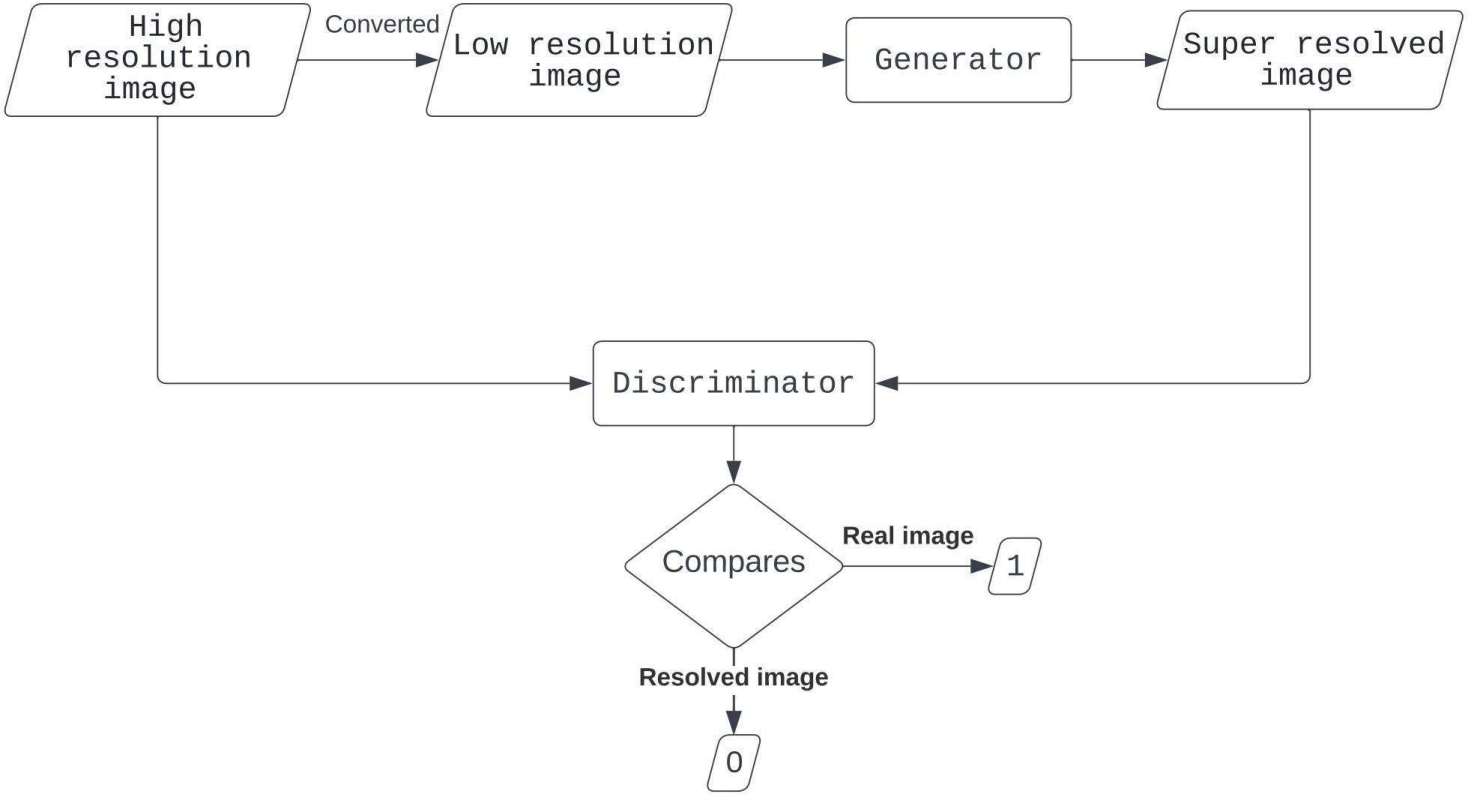
Use EasyOCR to read text

```
In [88]: reader = easyocr.Reader(['en'])
         result = reader.readtext(cropped_image)
         result

         CUDA not available - defaulting to CPU. Note: This module is much faster with a GPU.

Out[88]: [([[0, 0], [244, 0], [244, 53], [0, 53]], 'H982 FKL', 0.9769778047590311)]
```

Major Component of Project: Super resolution

- ESRGAN stands for Enhanced Super Resolution Generative Adversarial Network
- Two neural networks are used: Generator and Discriminator.
- Training GAN is hard and hence rewards are used
- Generator tries to generate high resolution images from low resolution images
- Discriminator tries to determine if the image is real or not.

During training of ESRGAN:



Low resolution image

ESRGAN super resolved image

Libraries used in ANPR

- **OpenCV:** a library of programming functions mainly aimed at real-time computer vision.
- **Bilateral Filter:** To remove the edge content and make transitions from one color to another
- **CVT COLOR:** To convert red green blue image to gray.
- **FIND_CONTOURS:** To find the contours in the image to make the transition easy
- **EasyOCR**
- **Matplotlib**

Use of Neural networks

- Artificial neural network inspired by biological neuron network.
- The system generates identifying characteristics from the data they have been passed
- Neural networks are based on computational models for threshold logic.

Conclusion

- We applied GAN neural network for super resolution on a Kaggle dataset
- The efficiency of the project is approximately 65%
- Very low resolution images do not get resolved clearly using ESRGAN
- After further improvements to make it suitable for the real world, ANPR using super resolution can be used in broad applications

Future work

- In this future, using GPU will increase the speed with which our code is executed.
- Advanced image filtering algorithms and deep learning methods can minimise inaccuracy in recognition of similar alphanumeric characters
- Use of better resolution algorithms like Google Enhance AI, TecoGAN to enhance very low resolution images
- Use of deep learning to reduce misidentification and increase reliability for databases

References

- Reference of ESARGAN- https://github.com/xinntao/ESRGAN
- Reference from research paper- https://research.ijcaonline.org/volume69/number9/pxc3887665.pdf
- Reference from research paper- https://www.ijert.org/research/automaticnumber-plate-recognition-system-anpr-system-IJERTV3IS071132.pd
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7579458/

References

- https://towardsdatascience.com/exploratory-data-analysis-8fc1cb20fd15
- Reference from reasearch paper of Pondicherry Engineerin College https://www.researchgate.net/publication/335586742_Automatic_number_plate_recognition_system_using_super-resolution_technique#:~:text=In%20super%20resolution%20technique%20was%20used%20for%20anpr,from%20the%20offender....%20Automatic%20Number%20Plate%20Recognition%20System
- Wikipedia.

THANK YOU