Practicum Project

“I Am Limited By the Technology of My Time”

~Sir Howard Stark

Automatic License Plate Recognition

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Aim of Project:

Building an Automatic License Plate Recognition System Using Machine Learning Techniques.

Objective:

The Aim Of This Project Is To Build An Automatic License Plate Recognition System And Improving Its Accuracy And Efficiency By Training It On A Machine Learning Model On A Large Dataset Of License Plate Images. We Seek To Develop A System That Can Accurately And Reliably Detect And Recognize License Plates In Real World Scenarios. The Detected Number Plates Will Be Saved In A Csv Sheet.

Technology Used:

* **Python**: Python Is A High-level Programming Language Known For Its Simplicity, Readability, And Versatility. It Was Created In 1991 And Emphasizes Code Readability And A Clean Syntax. Python Uses Indentation To Define Code Blocks And Has A Wide Range Of Modules And Functions In Its Libraries. It Supports Object-oriented, Procedural, And Functional Programming Paradigms. Python Complements Our Project As It Helps Is:

1. Image Processing
2. Optical Character Recognition
3. Pattern Matchmaking And Classification
4. Data Manipulation
5. Integration And Deployment

* **Machine Learning**: Machine Learning Is A Branch Of AI That Involves Creating Algorithms And Models That Can Learn From Data And Make Predictions Or Decisions Without Explicit Programming Instructions. It Enables Computers To Recognize Patterns, Make Predictions, And Improve Performance Based On Experience. Machine Learning Complements Our Project As It Helps In:

1. License Plate Localization
2. Character Segmentation
3. Optical Character Recognition
4. Pattern Recognition And Filtering
5. Post-processing And Error Correction

* **TensorFlow:** TensorFlow Is An Open-source Machine Learning Framework By Google. It Enables Developers To Build And Train Machine Learning Models. With A Computational Graph Concept, It Supports Deep Neural Networks, Provides High-level Apis And Offers Tools For Distributed Computing And Model Deployment. It Complements Our Project As It Helps In:

1. Training Object Detection Models
2. License Plate Character Recognition
3. Error Correction

* **Easy OCR:** OCR (Optical Character Recognition) Is A Technology That Recognizes And Extracts Text From Images Or Scanned Documents. It Uses Machine Learning Algorithms To Analyse Patterns And Features In The Input Data, Allowing For Automated Text Recognition And Conversion Into Machine-readable Formats. It Complements Our Project As It Helps In:

1. It Analyses And Interpret Alphanumeric Characters
2. Extract Number Plate Information
3. It Is Efficient And Reliable Identification Tool

* **JUPYTER Notebook:** It Is An Open-source Web Based Interactive Development Environment That Allows User To Create And Share Documents Containing Code, Equation, Visualizations. It Supports Various Programming Languages And Helps In Data Analysis In A User-friendly Interface.
* **Various Python Libraries:** Our Project Involves Use Of Many Python Libraries Such As:

1. Tensorflow\_addons
2. Gin-config
3. Wget
4. Matplotlib
5. Protobuf Ver 3.20
6. Pyyaml Ver 5.1
7. Pillow
8. Pytz
9. OpenCV-python Ver 4.6.0.66
10. NumPy

Working:

1. Real Time Webcam Or Existing Images Will Help Us Grabbing The Image Of License Plate.
2. TensorFlow Object Detection Will Be Used To Detect The Plate Trained On A Kaggle Dataset.
3. Easy OCR Is Used To Extract The Text And A Size Filtering Algorithm Is Used To Grab Largest Detection Region.

Methodology:

The Methodology Used in Automatic License Plate Recognition (ALPR) Systems Typically Involves the Following Steps:

1. **Image Acquisition**: Obtaining Image Or Video Stream Containing The License Plate(s) Of Interest Which Is Done Using Cameras Or Other Imaging Devices Positioned To Capture Vehicle License Plates. In This Case, We Have Used Dataset Obtained From Kaggle.

2. **Preprocessing**: Apply Preprocessing Techniques To Enhance The Quality And Readability Of The Captured Images. This May Involve Operations Like Image Resizing, Contrast Enhancement, And Normalization.

3. **License Plate Localization**: Use Computer Vision Techniques To Identify And Isolate Regions Of The Image That Potentially Contain License Plates. This May Include Edge Detection, Colour-based Segmentation, Or Machine Learning-based Object Detection.

4. **Character Segmentation**: If The License Plate Is Detected Successfully, The Next Step Is To Segment The Individual Characters On The License Plate Which Involves Separating The Characters From Each Other For Further Analysis. Techniques Like Connected Component Analysis, Contour Extraction, Etc Can Be Utilized.

5. **Character Recognition**: Perform Optical Character Recognition (OCR) On Each Segmented Character To Recognize The Alphanumeric Characters Present On The License Plate. Various Methods Can Be Employed, Such As Template Matching, Feature Extraction, Or Machine Learning Models Trained Specifically For Character Recognition.

6. **Post-processing**: Apply Post-processing Techniques To Refine The Recognized Characters And Improve Accuracy. This May Involve Spell-checking, Error Correction, Or Using Context And Language-specific Rules To Validate The Recognized Characters.

7. **License Plate Text Generation**: Combine The Recognized Characters To Form The Complete License Plate Text.

8. **Verification And Analysis**: Validate The Accuracy Of The Recognized License Plate Text By Comparing It With A Database Of Known License Plate Formats, Conducting Checks For Consistency, Or Using Additional Information. Perform Any Required Analysis Or Further Processing Based On The Recognized License Plate Information.

Solution It Provides:

Automatic License Plate Recognition (ALPR) Systems Solve Several Problems Related To The Efficient And Accurate Identification Of Vehicle License Plates. Here Are Some Key Problems That ALPR Addresses:

1. **Vehicle Identification**: ALPR Enables Automated Identification Of Vehicles By Capturing And Analysing Their License Plates. This Is Particularly Useful In Various Applications Such As Toll Collection, Parking Management, Law Enforcement, Traffic Monitoring, Etc.

2. **Time And Cost Efficiency**: ALPR Systems Automate The Process Of License Plate Recognition, Eliminating The Need For Manual Entry Or Visual Inspection. This Improves The Efficiency Of Tasks Such As Vehicle Registration, Toll Collection, Parking Enforcement, Or Security Monitoring, Reducing Human Effort, Time, And Associated Costs.

3. **Enhanced Security And Law Enforcement**: ALPR Helps Enhance Security Measures By Providing Real-time Monitoring And Identification Of Vehicles. It Enables Rapid Identification Of Stolen Vehicles, Vehicles Associated With Criminal Activities, Or Vehicles Violating Traffic Regulations. ALPR Systems Can Be Integrated With Databases, Allowing Law Enforcement Agencies To Instantly Check For Warrants, Vehicle Registration Status, Or Flag Suspicious Activities.

4. **Traffic Management And Surveillance**: ALPR Plays A Crucial Role In Traffic Management By Monitoring And Analysing Vehicle Movement. It Can Provide Valuable Data On Traffic Patterns, Average Speeds, Or Traffic Violations, Aiding In Traffic Planning, Optimization, And Enforcement Efforts.

5. **Parking Management**: ALPR Is Extensively Used In Parking Systems To Automate The Process Of Vehicle Identification And Parking Access Control. It Enables Efficient Management Of Parking Lots, Including Occupancy Tracking, Payment Automation, Permit Validation, And Preventing Unauthorized Parking.

6. **Data Analysis And Insights**: ALPR Systems Generate Data That Can Be Analysed For Various Purposes. It Helps In Understanding Traffic Flow Patterns, Identifying Peak Hours, Detecting Traffic Violations, Tracking Vehicle Movement, Or Generating Statistical Insights For Transportation Planning And Policy-making.

7. **Reducing Manual Errors**: ALPR Eliminates Manual Data Entry Errors That Can Occur When Humans Manually Transcribe License Plate Numbers. It Provides Accurate And Reliable License Plate Recognition, Reducing The Chances Of Mistakes And Improving The Overall Data Integrity.

8. **Automated Workflow Integration**: ALPR Systems Can Be Integrated Into Existing Workflows, Databases, Or Surveillance Systems, Allowing Seamless Integration And Automation Of Processes. This Facilitates Efficient Data Sharing, Record Keeping, And Integration With Other Systems For Comprehensive Analysis And Decision-making.

How’s this going to Work?

Real-time Webcam Feed or Existing Image: Your system can operate in real-time by capturing images directly from a webcam feed. This allows for instantaneous processing and recognition of license plates. Alternatively, you can also use existing images for license plate detection and recognition.



TensorFlow Object Detection for Plate Detection: To detect the license plate within the captured image, you can utilize TensorFlow's object detection capabilities. By training or using pre-trained models, you can accurately identify the bounding box or region of interest (ROI) containing the license plate in the image.



EasyOCR for Text Extraction and Size Filtering: Once the license plate region is identified, EasyOCR can be employed to extract the text from the detected region. EasyOCR is a Python library that performs optical character recognition (OCR) on images. It recognizes and extracts alphanumeric characters from the license plate image, enabling you to obtain the text information.



Steps:

1. Setup
2. Cloning Baseline Code
3. Creating A Virtual Environment
4. Installing Dependencies
5. Installing TensorFlow Object Detection
6. Cloning Pre-trained Model
7. Importing Dataset from Kaggle
8. Creating Training and Testing Partition from Our Dataset
9. Training Our Model

Er Diagram:

Synopsis:

Conclusion: