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Deep Learning Based OHE Data Preparation System for Railways

[1]Mr. Roshan Banbariya, [2] Prof. Shruti Dixit

[1]Department of ECE,

[1]Sagar Institute of Research and Technology, Bhopal M.P, India

Abstract : The preparation of Overhead Equipment (OHE) data in Indian railway is a challenging task. The deep learning based OHE data preparation system can replace the manual method of preparing data. An algorithm was designed to recognize the letters from an image and get the location data. For video recording a charge-coupled device (CCD) based camera and for location data a Global Positioning System (GPS) were used. The model was trained to identify the number plate and recognize the characters in it using optical character reorganization (OCR), obtained result will be saved in excel file.

IndexTerms **- CNN, Tensor flow, OCR, Pole detection, Number Identification, Number Recognition**

I. INTRODUCTION

The Indian Railways is the principal mode of transportation in India. The Indian Railways track is spread across 115,000 km. It is the largest rail network in Asia, and the world's second largest network operated under a single management. Maintaining such a large network is a huge task. The different automation technique is being implemented for the development and maintaining such a large network. The work is related to the Indian railway TP pole detection system. A method is proposed for the collection of telegraphic pole (TP) data. TP data consist of location of the electric pole in the Indian railways. Presently collection of TP data is done manually by using trolley-mounted equipment. Manual method of preparing data requires more manpower and high cost. With the advancement in the technology new tools and technique is being implemented. The new technique helps in reduction of cost and manpower. The research helps in fulfilling the gap of route data preparation using convolution neural network (CNN) technique. Neural network uses the trained model of TP plate for identification of new TP plate in an image. For plate detection first edge detection and basic morphological tools were used. The image is converted to grey scale for further processing and identification of plate. Although a lot of research is being performed in automatic vehicle number plate recognition this research is different due to various reasons such as the camera in this work will be fixed in the moving train.

Figure 1: Sample dataset

The overall system consists of GPS unit, Camera unit, and laptop. The overall block diagram consists of two processes Process -1 consist of pre- trained plates as trained model-1. The algorithm is applied in the obtained frames from HD camera. The GPS unit positioning at 10 Hz is used for high accuracy. In the second process the OCR algorithm is applied on the detected image. The OCR technique will be used for number abstraction from the detected plate. The overall process will be completed step by step in a single network. The final output data is saved in the excel file.

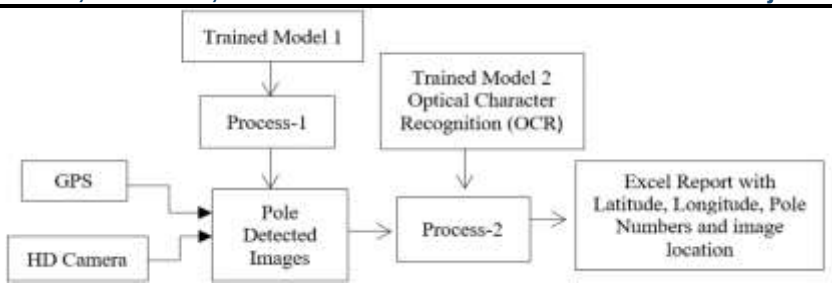

Figure 2: Working Block Diagram

II. LITERATURE REVIEW

A notable amount of work has been done over the last few years on image processing techniques and deep learning for object detection and recognition purpose.

Nazmus Saif et. Al [1] proposed a system to detect and recognize the Bangla license plate from an image of a vehicle using CNN used for both detection and recognition. The network is made using 53 convolutional layers based on YOLOv3 model. Device crops out the number plate region and recognize the characters, then moves to the next model i.e. YOLO for segmentation and image recognition. The system was able to execute 9 frames per second from the video.

H.Erdinc Kocera, K.Kursat Cevik [2] proposed a system of automatic vehicle license plate recognition system based on neural networks. A Camera is used to capture images with a dimension of 220X50 pixels. Characters were detected using canny edge detection and blob coloring method for separation of characters, license plates recognition rate was 95.36%..

Hamed Saghaei [3] proposed a system of Automatic License and Number Plate Recognition System for moving vehicles. License plate recognition (LPR) software was used to identify the license plates from images captured by a special camera. The LPR software uses different algorithms such as orientation, localization, normalization, segmentation, and finally OCR, the result is compared with results in database.

Cuong Nguyen, Dmitry Shashev [4] proposed an algorithm of object detection in video files by processing an Image file. Image-partitioning step is performed to determine whether it is area of object or background. Image area describes the surface properties of an image. The boundaries and points of an object are determined by relatively uniform grey level. The method was also compared with other methods in which the proposed method was resistance to noise, brightness change and less computational cost.

Madhusree Mondal et. al [5] proposed an ANPR based on (CNN). Self-synthesized function in CNN for distinguishing state code in number plate. For feature detection echelon format was used in the model. With the full image obtained from the retinal sensor visual cortex utilizes a 3-layer hierarchical approach, CNN has proved its robustness even for tilted and distorted image.

Andrew S. Agbemenu et. al [6] proposed an algorithm to detect and recognize Ghanaian license plate. It uses edge detection and feature detection algorithm for the detection of edges and matching with the template. The device is implemented for character segmentation, particularly with square plates to prevent noise effects, arrangement of characters. By using teseract OCR engine character recognition was performed. Feature detection was a good success rate but slightly low speed 0.185s detecting about 454 plates with 90.8% accuracy. The OCR model successfully detected 60 percent of the plates with an average time of 0.031s.

Hendry, Rung-Ching Chen [7] proposed an ANPR using YOLO darknet framework. The algorithm uses AOLP database which contained 6-digit car license plates. YOLO framework detects each digit separately and identifies it. The system is tested in different condition such as rainy background, darkness and dimness, and different hues. The system achieves approximately 98.22% accuracy.

III. PROPOSED METHODOLOGY

This Proposed System having mainly five modules. The working of each module is further divided into sub parts.

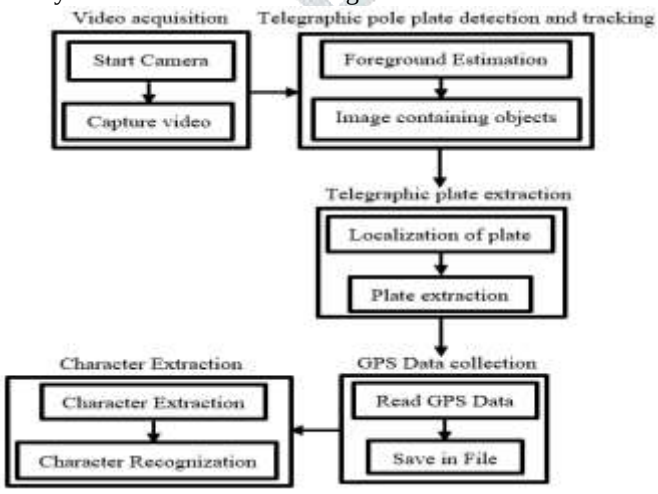

Figure 3: Flow of TP Plate Detection

1 **Video Acquisition:** In this module videos are taken by the camera fitted on the moving train. The algorithm has the ability to break the video into frames and process for detection algorithm. The process is carried out in a GPU based system for high-speed processing.

2 **Telegraphic pole plate detection and tracking:** In Telegraphic pole plate detection and tracking we have simulated various techniques like cropping of image, comparison with trained model, plate detection etc. each image frames are tested for plate availability in image by trained model.

3 **Telegraphic plate extraction:** Telegraphic plate is first located in current frame then they are extracted using Edge Detection Approach. The rectangular plate is detected and processed for number recognition.

Figure 4: Telegraphic Plate Detection

Figure 5: Telegraphic Plate Extraction

4 GPS Data collection: A 10 Hz GPS device with NMEA-0183 Protocol output is used as a GPS receiver. The last detected TP image frame's location is saved in the excel file.

```
Gps_data = ser.readline()
print (Gps_data)
```

```
$GPGSV,3,1,12,08,00,243,33,01,33,302,00,03,36,324,00,04,14,295,00*79
$GPGSV,3,2,12,10,40,109,00,21,33,296,00,22,48,331,00,23,11,123,00*74
$GPGSV,3,3,12,25,30,107,00,26,11,181,00,27,01,219,00,31,60,219,00*74
$GPRMC,121802,V,2312.9961,N,07723.8001,E,,,150921,000.0,W*78
$GPGGA,121802,2312.9961,N,07723.8001,E,0,00,,,M,,M,,*58
$GPGSA,A,1,,,,,,,,,,,,,,,*1E
$GPGSV,3,1,12,08,00,243,32,01,33,302,00,03,36,324,00,04,14,295,00*78
$GPGSV,3,2,12,10,40,109,00,21,33,296,00,22,48,331,00,23,11,123,00*74
$GPGSV,3,3,12,25,30,107,00,26,11,181,00,27,01,219,00,31,60,219,00*74
$GPRMC,121803,V,2312.9961,N,07723.8001,E,,,150921,000.0,W*79
$GPGGA,121803,2312.9961,N,07723.8001,E,0,00,,,M,,M,,*59
```

Figure 6: GPS Data Collection

5 Character Extraction: Detected TP plate image is passed to this model. The OCR model is used for character extraction. Feature extraction is performed first to recognize characters. In feature extraction the data from bitmap representation is transformed into a form of descriptors. A description of the character is a vector of numeral values, so called descriptors or patterns. At first each character are separated and split each characters and find length. Each character is correlated with the database. If both the value occurs to be same it will generate the value between 0-9 and A-Z. Finally, the data is Stored in the file.

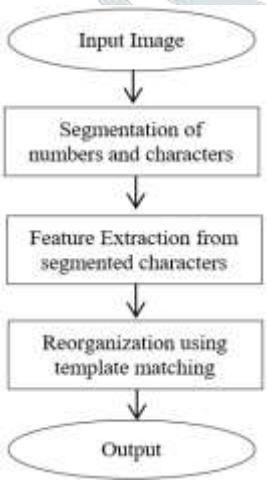

Figure 7: Flow Chart of OCR Process

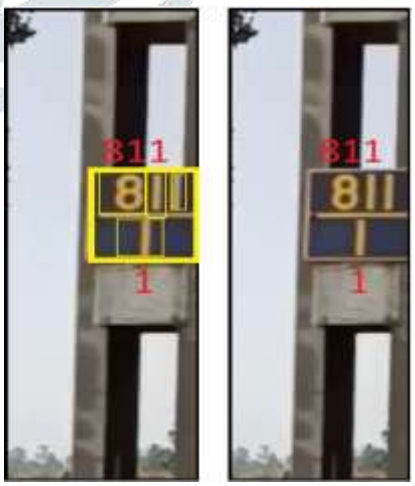

Figure 8: Character Extraction Using OCR

IV. RESULTS

The whole system is implemented in i5 machine. The tensor flow was implemented on collected dataset. The dataset obtained is split in the ratio of 4:1. 80% images in training dataset and 20% images in testing dataset. The model is able to achieves the throughput of 30 frames/s based on GPU in comparison to 8 frames/s based on CPU. So we observe significant improvement in GPU with the model. The proposed design-based software implementation got significant improvement in time taken for one complete cycle execution. Our model is able to run one forward cycle based on GPU is 50ms in comparison to traditional CPU based system which is 150ms. In contrast to existing approaches which take plate detection and number recognition as two separate

tasks and settle them step by step, our model jointly solves these two tasks by a single network. It avoids the intermediate error and accelerates the processing speed.

Detected plate:

To detect Frame.

Figure 9: Detected Image

Character Recognition:

OCR implemented on the TP plate for character recognition.

Figure 10: OCR Implemented on TP Plate

Excel file generation:

The excel file containing pole number, location information and sample image number is saved.

1	s.n	Pole.no	Latitude	Longitude	Image-no
2	1	973/41A	24.16585167	78.17512333	Img-001
3	2	973/39	24.16559667	78.1747	Img-002
4	3	973/37	24.165325	78.17425833	Img-003
5	4	973/35	24.16505667	78.173815	Img-004
6	5	973/33	24.16484833	78.17346667	Img-005
7	6	973/31	24.16471	78.17323667	Img-006
8	7	973/29	24.16444667	78.17279167	Img-007
9	8	973/27	24.164215	78.17240833	Img-008
10	9	973/25	24.16406	78.17215	Img-009
11	10	973/23	24.16384833	78.17180167	Img-010
12	11	973/21	24.16365833	78.17148333	Img-011
13	12	973/19	24.16345	78.17114167	Img-012

Figure 11: Excel File Generated

V. CONCLUSION

- A device with powerful image processing techniques can easily detect the TP from various angles.
- It plays an important role in the automation of the Route data preparation system.

VI. FUTURE WORK

- The detection and reorganization capability can be increased by a high configuration i7 GPU based system.
- The accuracy of system can be increased by a 60fps, HD long lens camera.
- The distance accuracy can be increased by an 18 Hz or better GPS Navigation System.

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