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Enhancing Image Recognition of Damaged Number Plate in the Running Vehicle using Genetic Algorithm Compared with Edge Detection Algorithm

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Abstract

Aim : Innovative novel automatic number plate detection of damaged vehicle number plates using machine learning algorithms and improving the accuracy of recognition using genetic algorithms. **Materials and methods :** Two sample groups using 237 images are used as the sample dataset, which is tested at 80% for G power with t-test analysis. To improve the accuracy of recognizing the number plates of the vehicle, the genetic algorithm is proposed and compared with the edge detection algorithm. **Results and Discussion**: Test results prove that the genetic algorithm has an average accuracy of 91.05%, which seems to be better than the edge detection algorithm's accuracy of 90.02%. Since the significance is around 0.46, there appears to be a statistically significant difference among the study group with ($p< 0.05$). **Conclusion:** Recognition of number plates of a vehicle using novel genetic algorithm can have an effect of detection of violation by road side CCTV cameras.

Keywords

Genetic Algorithm, Edge Detection Algorithm, Novel Automatic Number Plate Detection, Image Processing, Machine Learning, Image Recognition.

INTRODUCTION

Smart number plate recognition system uses the optical character recognition to perform image processing and machine learning algorithms to identify the owner of the car. It has become the most researched topic because of the increase in the number of cameras at every corner and road for effective monitoring (Dalarmelina et al. 2019). Smart cities and industry 4.0 are increasingly making the world highly connected and hence detection of a car using number plates can help Smart Parking System, Voiations, and provide owners information. (Lubna, Khan, and Mufti 2016). Number plate detection using Genetic Algorithm (GA) plays an important role in image processing for finding the boundaries of

an image recognition in an image (Israni and Jain 2016) and machine learning. Traffic management, monitoring vehicles at restricted zones, Intelligent parking system, toll payment and processing system are some of the important applications that can be used for this number plate identification system (Shreyas et al. 2017). Character segmentation, character image recognition, plate localization, connected component analysis and texture analysis are some of the other important application domains where the number plate detection system is proposed to find enhancement (Unnikrishnan, Romeo, and Rawther 2016).

The existing system of number plate image recognition is one of the most widely used research domains in the field of industrial automation and automobile industry. Deep learning algorithms have started to contribute to accuracy even if there is a level of damage and lack of visibility. Google Scholar has around 1400 papers since the 1990s and the Web of Science journal has around 300 papers contributing to this domain. Recently genetic algorithms and edge detection algorithms are getting improved results (Slimani et al. 2019). Detection and localization of vehicle number plates by generating the hypothesis and adaptive threshold for increasing the robustness has got accuracy (96%). (Prakash et al. 2017) proposed a non blind image deblurring machine learning algorithm for restoring the sharpness and edges of the images. (Saleem et al. 2016) proposed a vertical edge detection algorithm for detecting the edges of the vehicles and finding the discontinuous in gray scale images with an efficiency (84.8%). (Ha and Shakeri 2016) in this paper proposed a canny edge detection algorithm for localising the location of the vehicles for building the strong robustness by removing the noise and got an accuracy (84.28%). (Panahi and Gholampour 2017) proposed a methodology for detecting the vehicle number plates based on character image recognition and character segmentation and got an accuracy of 97% and this paper is mostly cited by 35 articles for detecting the number plates based on various weather conditions. Due to high computational cost genetic algorithms are not used frequently, however the concept has the ability to segment images depending on the stable colours. It identifies plates and non plate regions and defines shape rules(Al-Shemarry and Li 2020). Real time implementation using hardware platform tested for datasets of persian licence plates with varying degree of variety of vehicle conditions (Nguyen, Nguyen, and Chung 2015).

MATERIALS AND METHODS

The study setting of the proposed work is done in Compiler Design Lab, Saveetha University. The number of groups identified for the study is 2. Group 1 is a genetic algorithm and group 2 is the edge detection algorithm. The sample dataset taken for each group is 237 and the total dataset is divided and iterated 5 times through the two algorithms (D. Kim 2014).

Genetic algorithm is a natural processing algorithm, it is an optimization technique used in number plate detection systems. It enhances the input image with traits and recognizes each character one by one.

The edge detection algorithm is proposed for detecting the edges of the vehicle number plate. The input image is converted from RGB to Grey form by removing the discontinuous in grey scale images; this algorithm is also used for building the strong robustness by removing the noise in an image. A sample of the dataset with various attributes are presented in Table 1. There are totally 237 images that are considered as sample training data set images useful for the proposed genetic algorithm in detecting the damaged number plates.

Software tool used for detecting the accuracy rate of damaged number plates using python programming language. Hardware configuration was Intel core i5 (2.70 GHZ) processor with 8 GB RAM and 64bit OS, x64-based processor system. The Software configuration was the Windows 10 operating system. The data was pre-processed after

importing the dataset by removing noises. The dataset was splitted into two parts as training labels and testing records. The genetic algorithm and edge detection algorithms were evaluated with respect to training labels and testing records, the required parameter accuracy percentage was calculated.

Testing Procedure for Number Plate Detection using GA

To start with testing first import the dataset consisting of images.assign train labels to the data and get test tables for testing the images. Testing procedure starts with giving input image from the cars dataset downloaded from Kaggle website. The input image is preprocessed which enhances the input image making the image suitable for next level of processing.The input image is enhanced using the gaussian filter as shown in Fig. 1, by using this process the characters in the number plate becomes clearly visible without any other objects.

In preprocessing the number plate, the binarized image is converted into grey scale images by removing the noise which is shown in Fig. 2. By using these contours the image of the car's number plate should be shown by applying ratio and the rotations. Character segmentation is an operation that divides the image into subimages by dividing each and every character in the number plate, finally detecting the characters in text format as shown in Fig. 3. In Character recognition the characters are recognized by aspect ratio in the number plate, after finding the characters one by one it is used to check whether they have the same number plate or not.

Pseudocode For Genetic Algorithm

```
Let t = 0;
Create an initial population p(t);{calculat
Evaluate population p(t);{calculate the fitness function for each individual }
   while not termination do
          p(t) = variation[p(t)];
Evaluate population [p(t)];
         p(t+1)=apply genetic operations;{Next generation.}
         t = t +1;
end while
```

Edge Detection Algorithm

Testing Procedure for Number Plate Detection using Edge detection algorithm

Step 1 Import the image from the dataset downloaded from the kaggle website.

Step 2 Preprocessing the images and using them to enhance the edges of the image.

Step 3 Smoothing the input image by removing the noise without removing the original edges of the image.

Step 4 Detecting the enhanced edges by applying gabor filter techniques.

Step 5 Localization of the edge pixels for determining the exact location of the image.

Pseudocode for Edge Detection Algorithm

```
Define the edge
#processing section
      For all height i and width j pixels in range
            Extract pixel values of
                  Top and bottom
     Left and right
                  Top_left and top_right
  bottom _left and bottom_right
 Extract differences
Differences 1=top-bottom
Differences 2= top-right
Total difference= difference 1+ difference 2
Total difference=normal(total difference)+intensity
            Extract pixels  of the image
                        image_pixel=image[i,j]
           Extract edge_image
                Edge image[i,j]=image_pix*total difference
```

Statistical Analysis

This innovative damaged number plate detection system was tested on 237 car images. Each image is different in its length and also the environment conditions. Cars number plates used for detecting damaged number plates collected from kaggle website and the dataset is splitted as 80% is used as training and 20% is used for testing the images. The dependent variables are pixel width, resolution, and height and width of the number plate. The independent variables are date of image, size of the image, and location information.

RESULTS

In this innovative number plate detection research it is proved that the genetic algorithm appears to have better accuracy than the edge detection algorithm. Statistical analysis is done for comparing both genetic algorithm and edge detection algorithm using IBM SPSS version 21 tool. By taking accuracy,statistical analysis is performed in the SPSS tool.Parameters taken for comparison of both algorithms are accurate. Finally descriptive statistics applied for the dataset in SPSS.

From group statistics mentioned in Table 2, the mean, standard deviation and standard error mean are compared for the experimental algorithm genetic algorithm and edge detection algorithm. The genetic algorithm got a better mean accuracy value of 91.5 in comparison with the edge detection algorithm.In Table 3, the independent sample t-test results are shown with equal variance assumed as one category and without equal variance as another category. It's found that the level of significance is marginally better.

Fig. 1 represents the preprocessing of the input image by using the gaussian filter. Fig 2 The input image is converted into a binarized image by removing the noise in a smoothing technique. Fig 3 Process of character segmentation of the number plate is done by subdividing the original image into multiple segments and then the character is extracted from the number plate.

The graph in Fig. 4 represents the mean accuracy between the two algorithms. Genetic algorithms appear to produce consistent results with minimal standard deviation. There is a significant difference between genetic algorithms and the edge detection algorithm. The analysis observed that the genetic algorithm seems to be better than the edge detection algorithm in detection of damaged number plates.

DISCUSSION

It is observed that the genetic algorithm (91.05%) seems to have better accuracy than the traditional method of edge detection algorithm (90.02%) for damaged number plate detection.

Genetic algorithms are not accurate in classifying the segmentation of characters for large datasets. Large datasets can take more time for training and testing and also the accuracy of efficiency is less. Genetic algorithm is a complex model for detecting the images. As per the above findings it is proved that the genetic algorithm has got better results and shows the accuracy of 91.05%. The limitation of the proposed system is that a huge colour database has to be created manually extracting colours from number plates. In the future, this system can be implemented with OpenCV library and it can provide the high performance of the system design.

CONCLUSION

In this research, genetic algorithms appear with better accuracy percentage (91.5%) in detecting the damaged number plates. In the proposed method, characters in the damaged number plates are divided effectively by using character segmentation and character recognition methods.

DECLARATIONS

Conflict of interests

No conflict of interest in this manuscript.

Author Contribution

Author YHV was involved in data collection, data analysis, manuscript writing. Author TPA was involved in conceptualization, guidance and critical review of manuscript.

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REFERENCES

Al-Shemarry, Meeras Salman, and Yan Li. 2020. "Developing Learning-Based Preprocessing Methods for Detecting Complicated Vehicle Licence Plates." *IEEE Access*. https://doi.org/10.1109/access.2020.3024625.

Benin, S. R., S. Kannan, Renjin J. Bright, and A. Jacob Moses. 2020. "A Review on Mechanical Characterization of Polymer Matrix Composites & Its Effects Reinforced with Various Natural Fibres." *Materials Today: Proceedings* 33 (January): 798–805.

Dalarmelina, Nicole do Vale, Nicole do Vale Dalarmelina, Marcio Andrey Teixeira, and Rodolfo I. Meneguette. 2019. "A Real-Time Automatic Plate Recognition System Based on Optical Character Recognition and Wireless Sensor Networks for ITS." *Sensors*. https://doi.org/10.3390/s20010055.

Gudipaneni, Ravi Kumar, Mohammad Khursheed Alam, Santosh R. Patil, and Mohmed Isaqali Karobari. 2020. "Measurement of the Maximum Occlusal Bite Force and Its Relation to the Caries Spectrum of First Permanent Molars in Early Permanent Dentition." *The Journal of Clinical Pediatric Dentistry* 44 (6): 423–28.

Ha, Pooya Sagharichi, and Mojtaba Shakeri. 2016. "License Plate Automatic Recognition Based on Edge Detection." In *2016 Artificial Intelligence and Robotics (IRANOPEN)*. IEEE. https://doi.org/10.1109/rios.2016.7529509.

Israni, Sheetal, and Swapnil Jain. 2016. "Edge Detection of License Plate Using Sobel Operator." In *2016 International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT)*. IEEE. https://doi.org/10.1109/iceeot.2016.7755367.

Kim, Dongwook. 2014. "Car License Plate Detection Based on Line Segments." https://doi.org/10.14257/astl.2014.58.21.

Kim, Jung-Hwan, Sun-Kyu Kim, Sang-Hyuk Lee, Tae-Min Lee, and Joonhong Lim. 2017. "License Plate Detection and Recognition Algorithm for Vehicle Black Box." In *2017 International Automatic Control Conference (CACS)*. IEEE. https://doi.org/10.1109/cacs.2017.8284273.

Lubna, M. F. Khan, and N. Mufti. 2016. "Comparison of Various Edge Detection Filters for ANPR." In *2016 Sixth International Conference on Innovative Computing Technology (INTECH)*. IEEE. https://doi.org/10.1109/intech.2016.7845061.

Nalini, Devarajan, Jayaraman Selvaraj, and Ganesan Senthil Kumar. 2020. "Herbal Nutraceuticals: Safe and Potent Therapeutics to Battle Tumor Hypoxia." *Journal of Cancer Research and Clinical Oncology* 146 (1): 1–18.

Nguyen, Chi Toan, Thanh Binh Nguyen, and Sun-Tae Chung. 2015. "Reliable Detection and Skew Correction Method of License Plate for PTZ Camera-Based License Plate Recognition System." *2015 International Conference on Information and Communication Technology Convergence (ICTC)*. https://doi.org/10.1109/ictc.2015.7354726.

Panahi, Rahim, and Iman Gholampour. 2017. "Accurate Detection and Recognition of Dirty Vehicle Plate Numbers for High-Speed Applications." *IEEE Transactions on Intelligent Transportation Systems*. https://doi.org/10.1109/tits.2016.2586520.

Prakash, A. R., M. Jagannath, K. Adalarasu, and G. Mohan Babu. 2017. "Vehicle License Plate Detection and Recognition Using Non-Blind Image de-Blurring Algorithm." In *2017 International Conference on Nextgen Electronic Technologies: Silicon to Software (ICNETS2)*. IEEE. https://doi.org/10.1109/icnets2.2017.8067895.

Reddy, Poornima, Jogikalmat Krithikadatta, Valarmathi Srinivasan, Sandhya Raghu, and Natanasabapathy Velumurugan. 2020. "Dental Caries Profile and Associated Risk Factors Among Adolescent School Children in an Urban South-Indian City." *Oral Health & Preventive Dentistry* 18 (1): 379–86.

Saleem, Nauman, Hassam Muazzam, H. M. Tahir, and Umar Farooq. 2016. "Automatic License Plate Recognition Using Extracted Features." In *2016 4th International Symposium on Computational and Business Intelligence (ISCBI)*. IEEE. https://doi.org/10.1109/iscbi.2016.7743288.

Sasi, Anumol, Swapnil Sharma, and Alice N. Cheeran. 2017. "Automatic Car Number Plate Recognition." In *2017 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS)*. IEEE. https://doi.org/10.1109/iciiecs.2017.8275893.

Sathish, T., and S. Karthick. 2020. "Gravity Die Casting Based Analysis of Aluminum Alloy with AC4B Nano-Composite." *Materials Today: Proceedings* 33 (January): 2555–58.

Sathish, T., D. Bala Subramanian, R. Saravanan, and V. Dhinakaran. 2020. "Experimental Investigation of Temperature Variation on Flat Plate Collector by Using Silicon Carbide as a Nanofluid." In *PROCEEDINGS OF INTERNATIONAL CONFERENCE ON RECENT TRENDS IN MECHANICAL AND MATERIALS ENGINEERING: ICRTMME 2019*. AIP Publishing. https://doi.org/10.1063/5.0024965.

Shreyas, R., B. V. Pradeep Kumar, H. B. Adithya, B. Padmaja, and M. P. Sunil. 2017. "Dynamic Traffic Rule Violation Monitoring System Using Automatic Number Plate Recognition with SMS Feedback." In *2017 2nd International Conference on*

Telecommunication and Networks (TEL-NET). IEEE. https://doi.org/10.1109/tel-net.2017.8343528.

Sivasamy, Ramesh, Potu Venugopal, and Rodrigo Espinoza-González. 2020. "Structure, Electronic Structure, Optical and Magnetic Studies of Double Perovskite Gd2MnFeO6 Nanoparticles: First Principle and Experimental Studies." *Materials Today Communications* 25 (December): 101603.

Slimani, Ibtissam, Abdelmoghit Zaarane, Abdellatif Hamdoun, and Issam Atouf. 2019. "Vehicle License Plate Localization and Recognition System for Intelligent Transportation Applications." In *2019 6th International Conference on Control, Decision and Information Technologies (CoDIT)*. IEEE. https://doi.org/10.1109/codit.2019.8820446.

Unnikrishnan, Arya P., Roshini Romeo, and Fabeela Ali Rawther. 2016. "License Plate Localization Using Genetic Algorithm Including Color Feature Extraction." *Procedia Technology*. https://doi.org/10.1016/j.protcy.2016.05.173.

Venu, Harish, and Prabhu Appavu. 2021. "Experimental Studies on the Influence of Zirconium Nanoparticle on Biodiesel–diesel Fuel Blend in CI Engine." *International Journal of Ambient Energy* 42 (14): 1588–94.

Yousif, Bedir Bedir, Mohamed Maher Ata, Nehal Fawzy, and Marwa Obaya. 2020. "Toward an Optimized Neutrosophic K-Means with Genetic Algorithm for Automatic Vehicle License Plate Recognition (ONKM-AVLPR)." *IEEE Access: Practical Innovations, Open Solutions* 8: 49285–312.

Tables and Figures

Table 1 Sample data sets with 237 images depicting the number plates of various cars. It consists of attributes like resolution, height and width of the image. Also damaged car licence plates are included in the dataset which is taken from the kaggle dataset.

File name	Width	height	class	xmin	ymin	xmax	ymax
	149	43	Licence plate	283	177	432	220
	1374	294	Licence plate	121	43	1495	337
	459	239	Licence plate	26	15	485	254
	148	54	Licence plate	48	291	196	345
	113	58	Licence plate	61	131	174	189

Fig. 1 preprocessing the input image by using the gaussian filter.

Fig. 2 The input image is converted into a binarized image by removing the noise in a smoothing technique.

Fig 3 Process of character segmentation of the number plate is done by subdividing the original image into multiple segments and then the character is extracted from the number plate.

Table 2 Group statistics results (Mean of genetic algorithm 91.05 appears to be more compared with edge detection algorithm(90.02%) and Standard Error Mean for genetic algorithm is 1.827 and edge detection algorithm is .1.029)

	Groups	**N**	**Mean**	**Std.Deviation**	**Std.Error Mean**
Accuracy	Genetic Algorithm	5	91.05	4.08656	1.82757
	Edge detection algorithm	5	90.02	2.30217	1.02956

Table 3 Independent Sample T- test Result is applied for dataset fixing confidence interval as 95% and level of significance as <0.05 (genetic appears to perform significantly better than edge detection algorithm)

		Lavene's test for equality of variances		**T-test for Equality of Means**					**95% confidence interval of the difference**	
		F	**Sig**	**t**	**df**	**sig(2 tailed)**	**Mean diff**	**Std.error**	**Lower**	**Upper**
Accuracy	**Equal Variances assumed**	0.586	.046	5.72	8	.583	1.70800	1.20000	-3.6372	6.03712
	Equal Variances not assumed			5.72	4.983	.587	1.70800	1.20000	-3.8762.	6.27280

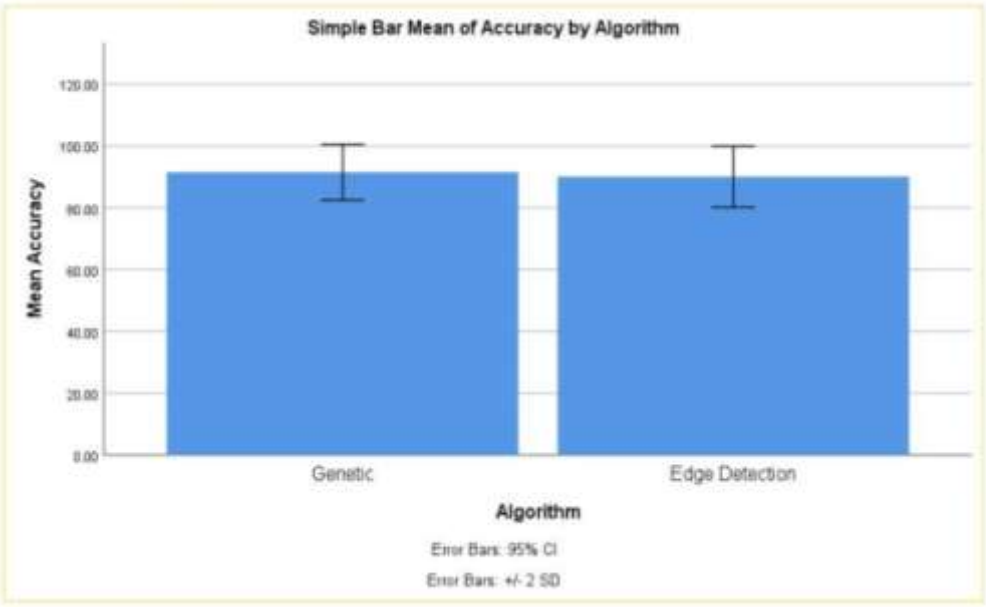

Fig. 4 Comparison of mean accuracy between genetic algorithm over edge detection algorithm, where the former is better than the later with 2.5% increase. X axis gives the algorithms and Y Axis: Mean accuracy of detection ± 1 SD.