BALTIC JOURNAL OF LAW & POLITICS
A Journal of Vytautas Magnus University
VOLUME 15, NUMBER 4 (2022)
ISSN 2029-0454

Cite: *Baltic Journal of Law & Politics* 15:4 (2022): 111-118
DOI: 10.2478/bjlp-2022-004011

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

Y. Harshavardhan
Project Scholar, Department of Computer Science and Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamilnadu. India. Pincode: 602105.
Email: harshavardhany18@saveetha.com

T.P. Anithaashri
Project Guide, Corresponding Author, Professor, Department of Computer Science and Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, Tamilnadu. India. Pincode: 602105.
Email: anithaashritp.sse@saveetha.com

Received: August 8, 2022; reviews: 2; accepted: November 29, 2022.

ABSTRACT

Aim: Automatic number plate detection of damaged number plates of the vehicle using image processing algorithms and improving the accuracy rate of readability in recognition of the number plates. **Materials and methods:** Two sample groups using 237 images from the sample dataset, which is tested at 80% for G power with t-test analysis. To improve the accuracy of recognition, the genetic algorithm is proposed and compared with the morphological dilation algorithm. **Results:** Test results prove that the genetic algorithm has an accuracy of 92.8%, which seems to be better than the morphological dilation algorithms accuracy of 90.82%. Since the significance is around 0.046, there is a statistically significant difference among the study group with ($p<0.05$). **Conclusion:** For distorted and damaged images, the detection and recognition of number plates using the genetic method seems to appear better than the morphological dilation algorithm. Detection of violations using road side cameras can perform better with proposed work.

INTRODUCTION

The aim of this study is to detect the damaged number plates using machine learning algorithms (Jain, Vishal, Zitha Sasindran, 2016). Number plate detection using morphological dilation algorithms plays an important role in adding the pixels to the boundaries of the Image processing by using the structuring element (Mohanan, Neeraja, Afaq Ahmed 2018). The applications of number plate detection using morphological dilation algorithms are used in automatic gate openers and toll collection systems (Vaishnav, Arun, and Manju Mandot. 2018) one of the main applications of Automatic number plate detection is automation of weigh in systems (Jagtap, Jayash, and Sushil Holambe. 2018).
The existing system has 237 research papers published and 12 Nos. of IEEE journal papers are published. In earlier times most of the pattern Object recognition was applied in machine learning and image processing (Khairul Islam, and Md Mostafizur Rahman.

2018.). It is applied in genetic algorithms and morphological dilation algorithms which are getting improved results (Kakani, Bhavin V., Divyang Gandhi, and Sagar Jani. 2017). In this paper (Suvon, Khan, and Ferdous 2020) proposed a convolutional neural network for Objects recognition of the vehicles present in the states based on the number plates of the vehicles with an accuracy (90%). (Mondal et al. 2017) proposed an entropy based svm technique for detecting the vehicles for security purposes with an accuracy (99.5%). The papers (Khan et al. 2018) proposed an YOLOv3 algorithm for optical character Object recognition with an accuracy (91.38%). In this (Vijayalakshmi, Sindhu, and Suriya 2020) paper proposed optical character recognition with a morphological algorithm to detect the vehicle where it presents with the help of a cloud database with an accuracy (89.4%). In one of the (Babu and Raghunadh 2016) proposed a template matching algorithm for detecting the exact location of the vehicles based on the number plates on various illuminated conditions.
Previously our team has a rich experience in working on various research projects across multiple disciplines (Venu and Appavu 2021; Gudipaneni et al. 2020; Sivasamy, Venugopal, and Espinoza-González 2020; Sathish et al. 2020; Reddy et al. 2020; Sathish and Karthick 2020; Benin et al. 2020; Nalini, Selvaraj, and Kumar 2020).The research gap in the existing system provides less efficiency in identifying damaged number plates which automatically leads to decrease in accuracy (Mohanan, Neeraja, Afaq Ahmad,2018). The aim of this study is to detect damaged number plates with the improvised accuracy rate of readability using the genetic algorithm compared with morphological dilation algorithm (Rabbani, Golam, 2018).

MATERIALS AND METHODS

The study setting of the proposed work is done in Compiler Design Lab, Saveetha School of Engineering, Saveetha University. The number of groups identified for the study is 2. Group 1 is a genetic algorithm and group 2 is the morphological dilation algorithm. The sample dataset taken for each group is 237 and the total dataset is divided and iterated for 5 times through the two algorithms.
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 the object recognizes each character one by one. The morphological dilation algorithm is proposed for detecting the image pixels of the vehicle number plate. It contains input as two: one is data and the other is a structured element. It is used mostly for binary images. 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 morphological dilation 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 Genetic Algorithm

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 the object recognizes each character one by one.
Step 1 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.
Step 2 Testing procedure starts with giving input image from the cars dataset downloaded from Kaggle website.

Step 3 The input image is preprocessed which enhances the input image making the image suitable for the next level of processing.
Step 4 The input image is enhanced using the gaussian filter by using this process the characters in the number plate become clearly visible without any other objects.
Step 5 In cleaning the number plate the binarized image is converted into grey scale images by removing the noise which is shown in Fig. 1.
Step 6 By using these contours the image of the car's number plate should be shown by applying ratio and the rotations.
Step 7 Character segmentation is an operation that divides the image into subimages by dividing each and every character in the number plate. finally detects the characters in text format as shown in Fig. 1.
Step 9 In Character recognition the characters are recognized by aspect ratio in the number plate.
Step 10 After finding the characters one by one it is used to check whether have the same number plate or not which is presented in Fig. 1.

Pseudocode for Genetic Algorithm

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
```

Morphological dilation Algorithm
The morphological dilation algorithm is proposed for detecting the image pixels of the vehicle number plate. It contains input as two: one is data and the other is structured element.it is used mostly for binary images.

Testing Procedure for Number Plate Detection using Morphological dilation algorithm
Step 1 Import the image from the dataset downloaded from the kaggle website.
Step 2 It takes input as two pieces one as data and the other as structuring element
Step 3 Structuring element shows the dilation of the input image
Step 4 Then the input image is converted into a binary image by removing the noise by considering the background pixels of the image.
Step 5 Then the binary image is converted into a grayscale image with a flat shaped structuring element.
Step 6 Localization of the vehicle number plate as the output.

Pseudocode For morphological dilation Algorithm

```
MM1 dilation
    For PE X do
    For CE X DE do
    image=(P+E)
End for
MM2 dilation
   For PE fr(X) do
   For CESE do
   Image (P+E)=1%
End for
```

Statistical Analysis

This innovation 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 morphological dilation algorithm. Statistical analysis is done for comparing both genetic algorithm and morphological dilation algorithm using SPSS 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 1, the mean, standard deviation and standard error mean are compared for our experimental algorithm genetic algorithm and morphological dilation algorithm. The genetic algorithm got a better mean accuracy value of (92.8%) in comparison with the morphological dilation algorithm.

In the above Table 2, 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. 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 morphological dilation algorithm).

The above graph in Fig. 1 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 morphological dilation algorithm. The analysis observed that the genetic algorithm seems to be better than the morphological dilation algorithm in detection of damaged number plates.

DISCUSSION

There are similar research papers on the detection of vehicle number plates using Machine Learning and deep learning algorithms. (Mohanan, Neeraja, Afaq Ahmed 2018) proposed a spatial mapping algorithm for feature extraction in detecting the vehicle's number plate with an accuracy (91.18%) (Mukherjee et al. 2017)). The morphological algorithms are applied in identification of images with template matching techniques for detecting the Bangla licence plate with an efficiency (93.5%) (Roy, Hossen, and Nag 2016). In this paper

(Joseph et al. 2019) proposed a width transform algorithm to detect the text area of the number plates by using morphological operations with an accuracy of (98%).
As per the above findings, it is proved that the genetic algorithm has got better results and performance. The limitation of this system is that a huge colour database was to be created manually extracting colours from number plates. The morphological dilation algorithms for automatic number plate recognition systems can be implemented as a future work.

CONCLUSION

It is inferred that the genetic algorithm seems to appear with better accuracy percentage (92.8%) in detecting the damaged number plates than the morphological dilation algorithm with the accuracy of (90.82%).

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.

Acknowledgments
The authors would like to express their gratitude towards Saveetha School of engineering, Saveetha Institute of Medical and Technical Sciences (Formerly known as Saveetha University) for providing the necessary infrastructure to carry out this work successfully.

Funding
We thank the following organizations for providing financial support that enabled us to complete the study.

1. Manac Infotech Private Limited, Hyderabad.
2. Saveetha University
3. Saveetha Institute of Medical and Technical Sciences.
4. Saveetha School of engineering.

REFERENCES

Babu, K. Mahesh, and M. V. Raghunadh. 2016. "Vehicle Number Plate Detection and Recognition Using Bounding Box Method." In *2016 International Conference on Advanced Communication Control and Computing Technologies (ICACCCT)*. IEEE. https://doi.org/10.1109/icaccct.2016.7831610.

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.

Chowdhury, Wasif Shafaet, Ashikur Rashid Khan, and Jia Uddin. 2018. "Vehicle License Plate Detection Using Image Segmentation and Morphological Image Processing." *Advances in Intelligent Systems and Computing*. https://doi.org/10.1007/978-3-319-67934-1_13.

Fomani, Babak Abad, and Asadollah Shahbahrami. 2017. "License Plate Detection Using Adaptive Morphological Closing and Local Adaptive Thresholding." *2017 3rd International Conference on Pattern Recognition and Image Analysis (IPRIA)*. https://doi.org/10.1109/pria.2017.7983035.

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.

Joseph, Jissy, Anuja Prasad, T. S. Jithina, and Leena Mary. 2019. "A Study on Localization Techniques for Automatic License Plate Recognition System." In *2019 2nd International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT)*. IEEE. https://doi.org/10.1109/icicict46008.2019.8993319.

Khan, Muhammad Attique, Muhammad Sharif, Muhammad Younus Javed, Tallha Akram, Mussarat Yasmin, and Tanzila Saba. 2018. "License Number Plate Recognition System Using Entropy-based Features Selection Approach with SVM." *IET Image Processing*. https://doi.org/10.1049/iet-ipr.2017.0368.

Mohanan, Neeraja, Afaq Ahmad, Sayyid Samir Al-Busaidi, Lazhar Khiriji, Amir Abdulghani, and Muhammad Al Nadabi. 2018. "Use of Mathematical Morphology in Vehicle Plate Detection." *Oriental Journal of Computer Science and Technology*. https://doi.org/10.13005/ojcst11.04.04.

Mondal, Madhusree, Parmita Mondal, Nilendu Saha, and Paramita Chattopadhyay. 2017. "Automatic Number Plate Recognition Using CNN Based Self Synthesized Feature Learning." In *2017 IEEE Calcutta Conference (CALCON)*. IEEE. https://doi.org/10.1109/calcon.2017.8280759.

Mukherjee, Rajshekhar, Amit Pundir, Dharmendra Mahato, Gaurav Bhandari, and Geetika Jain Saxena. 2017. "A Robust Algorithm for Morphological, Spatial Image-Filtering and Character Feature Extraction and Mapping Employed for Vehicle Number Plate Recognition." In *2017 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET)*. IEEE. https://doi.org/10.1109/wispnet.2017.8299884.

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.

Pasrun, Y. P., M. Muchtar, A. N. Basyarah, and Noorhasanah. 2020. "Indonesian License Plate Detection Using Morphological Operation." *IOP Conference Series: Materials Science and Engineering*. https://doi.org/10.1088/1757-899x/797/1/012037.

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.

Roy, Animesh Chandra, Muhammad Kamal Hossen, and Debashis Nag. 2016. "License Plate Detection and Character Recognition System for Commercial Vehicles Based on Morphological Approach and Template Matching." In *2016 3rd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT)*. IEEE. https://doi.org/10.1109/ceeict.2016.7873098.

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.

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.

Suvon, Md Naimul Islam, Riasat Khan, and Mehebuba Ferdous. 2020. "Real Time Bangla Number Plate Recognition Using Computer Vision and Convolutional Neural Network." In *2020 IEEE 2nd International Conference on Artificial Intelligence in Engineering and Technology (IICAIET)*. IEEE. https://doi.org/10.1109/iicaiet49801.2020.9257843.

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.

Vijayalakshmi, N., S. Sindhu, and S. Suriya. 2020. "Automatic Vehicle Number Recognition System Using Character Segmentation and Morphological Algorithm." In *2020 IEEE International Conference on Advances and Developments in Electrical and Electronics Engineering (ICADEE)*. IEEE. https://doi.org/10.1109/icadee51157.2020.9368901.

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

Table. 2. Group statistics results (Mean of genetic algorithm (92.8%) appears to be more compared with morphological dilation algorithm(90.02%) and Standard Error Mean for genetic algorithm is 1.8603 and morphological dilation algorithm is (1.772)

	Groups	N	Mean	Std.Deviation	Std.Error Mean
Accuracy	Genetic Algorithm	5	92.8000	1.92354	1.8603
	Morphological dilation algorithm	5	90.2000	3.96232	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 morphological dilation 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**	0.889	.046	1.320	8	.023	2.60000	1.96977	-1.94320	7.14230
	Equal Variances not assumed			1.320	5.786	.037	2.60000	1.96977	-2.26337	7.46337

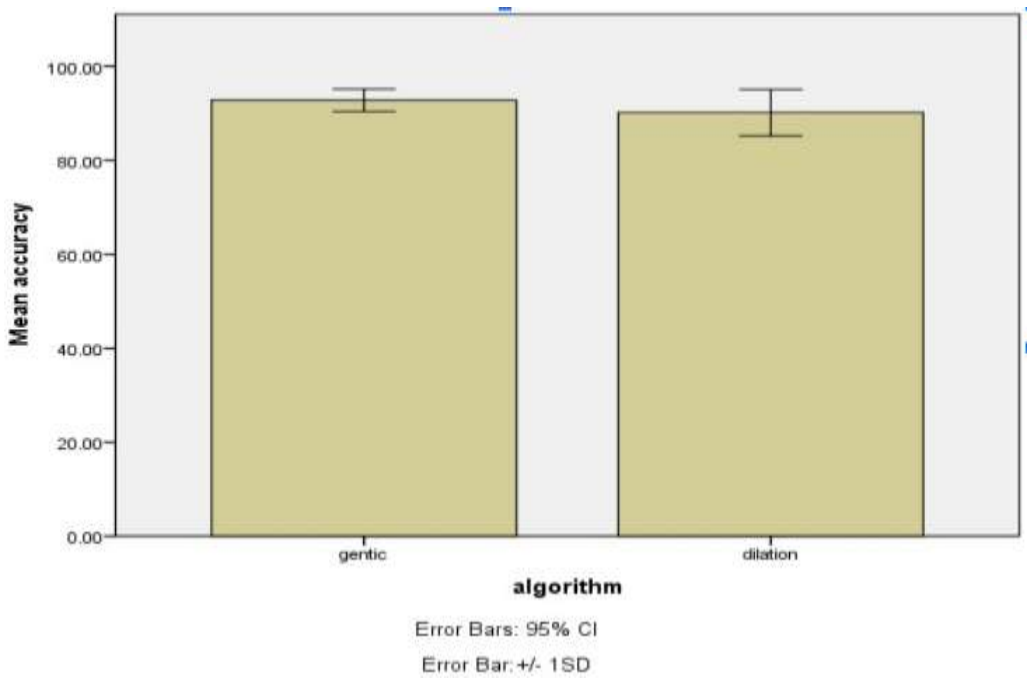

Fig. 1. Comparison of mean accuracy between genetic algorithm over morphological dilation algorithm, where the former is better than the later with 2.5% increase. X-Axis gives the algorithms and - Axis: Mean accuracy of detection ± 1 SD.