ENHANCING THE ACCURACY IN HANDWRITTEN CHARACTER RECOGNITION USING NOVEL OPEN SCALE-INVARIANT FEATURE TRANSFORM ALGORITHM OVER CONVOLUTIONAL NEURAL NETWORK

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Article History: Received: 12.12.2022 **Revised:** 29.01.2023 **Accepted:** 15.03.2023

Abstract

Aim: To enhance the Accuracy in Handwritten Character using Novel Open Scale invariant feature transform (SIFT) and Convolutional Neural Network (CNN).
Materials and Methods: This study contains 2 groups i.e Novel Open Scale Invariant Feature Transform and Convolutional Neural Network. Each group consists of a sample size of 20 and the study parameters include alpha value 0.05, beta value 0.2 and the power value 0.8. Their accuracies are compared with each other using different sample sizes also.
Results: The Novel Open Scale Invariant Feature Transform is 96.97% more accurate than the Convolutional Neural Network of 94.33% in Handwritten Character Recognition.
Conclusion: The SIFT model is significantly better than the CNN in Enhancing the Accuracy in Handwritten Character.

Keywords: Convolutional Neural Network, Novel Open Scale Invariant Feature Transform (SIFT), Handwritten Character, Accuracy, Recognition.

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1. Introduction

Handwriting is one in every of the foremost vital ways of communication. It was used since the Stone Age wherever symbols were drawn on stones so as to specific or convey some significant data (Lu et al. 2017). Handwriting was used for private edges like writing reminders and notes for ourselves or for business functions like writing letters, statements and filling up forms (EEE Staff 2015). The handwriting of every individual is exclusive as a result of method. The method of handwriting could be a physical process that involves the mind, skeleton and muscles, controlled by the brain (Ahmed, Razzak, and Yusof 2019). Even so, individual handwriting might conjointly take issue, supporting the mood and also the state of mind of the person writing (Sze et al. 2020). Applications of Handwriting Character Recognition include reading a lot of postal addresses, bank check amounts & forms and old calligraphic scripts (W. Q. Zhang, Chan, and Vahid 2022).

A Character Recognition System is employed to spot the character from a picture. Character recognition is the science of distinguishing a personality from image data or the other data supporting whether or not dynamic info is on the market or not (Siahaan and Sianipar 2021). The former one is termed as on-line and also the latter as offline supported the context of accessible info concerning knowledge the information that requires to be regenerated into editable text or machine explainable data (Gong et al. 2014). These pictures may be either written or composed and will have varied size and matter designs (Management Association and Information Resources 2018). Character recognition plays an awfully vital job in automation of communicating administrations, bank getting ready, report studying and so on (Hackeling 2017). It's a novel issue within the field of machine insight. Exceptional instrumentality (for example keen pen or weight touchy tablets), that is work of estimating pen's weight and speed is employed in on-line character acknowledgment which has the ID of character whereas they're being composed. Then again, for offline, filtered advanced photos of characters composed on a paper by the pen area unit used (Sivakumar Reddy et al. 2021).

Our institution is keen on working on latest research trends and has extensive knowledge and research experience which resulted in quality publications (Rinesh et al. 2022; Sundararaman et al. 2022; Mohanavel et al. 2022; Ram et al. 2022; Dinesh Kumar et al. 2022; Vijayalakshmi et al. 2022; Sudhan et al. 2022; J. A. Kumar et al. 2022; Sathish et al. 2022; Mahesh et al. 2022; Yaashikaa et al. 2022)The research gap in Handwritten Character Recognition is the availability of real time data sets and the accuracy to be improved. The selection of the algorithm also plays a vital role in Handwritten Character Recognition. So, this research focuses on improved accuracy in Handwritten Character Recognition Using Novel Open Scale-Invariant Feature Transform Algorithm Over Convolutional Neural Network (H. Zhang et al. 2009).

2. Materials and Methods

This study setting was done in the Machine learning Lab, Saveetha Institute of Medical and Technical Science. Sample size for this project is 20 (Group 1=10, Group 2=10). In Handwritten Character Recognition to modify the problem of low accuracy rate Novel Open Scale-Invariant Feature Transform Algorithm Over Convolutional Neural Network is used. Novel Open Scale-Invariant Feature Transform Algorithm learns user preference and Handwritten Character accordingly. Convolutional Neural Network enables thorough exploration of diverse data present. Mean accuracy of Novel Open Scale-Invariant Feature Transform Algorithm is 96.97%. Mean accuracy of keyword map algorithm is 94.33%.Dataset for this article is collected with 1125 rows.

SIFT (Scale-Invariant Feature Transform) may be a pc vision feature detection technique for detection and describing native options in photos. beholding, robotic mapping and navigation, image sewing, 3D modeling, gesture recognition, video chase, individual animal identification, and match moving area unit a number of the applications. Object SIFT keypoints are initially retrieved and saved in an exceedingly large amount of info from a set of reference pictures. The pseudocode for scale-invariant feature rework is shown in Table one. Associate in Nursing item in an exceedingly new image is known by scrutiny of every feature within the new image to the present info and discovering doable matching options supporting the geometrician distance between their feature vectors.

The Convolutional Neural Network (CNN) are basic devices for profound learning, and are significantly fitted to image acknowledgment. Convolutional neural systems utilize photos squarely as info (Ziyi Shen et al. 2019). The convolution arranges plays out the capacities that are performed by cells within the visual area, as an example, extricating basic visual parts like placed edges, end-focuses, corners, and then forth (K. R.

Kumar et al. 2016). Convolutional neural systems encompass convolutional layers that take away useful knowledge from the knowledge and put off superfluous fluctuation (Labati et al. 2015). Every innovative convolutional system is created out of a channel bank, and highlights pooling layers. Pseudocode for the SVM formula is shown in table a pair of. With varied stages, a convolutional system will learn multi-level chains of importance of parts.

Data Preparation

To perform Handwritten Character Recognition the real time data sets used are Semantic Analysis. The input data set for the proposed work is Sentiment Analysis collected from (https://www.kaggle.com/therealsampat/handwritten-character-recognition.)

Open Scale Invariant Feature Transform (SIFT)

SIFT (Scale-Invariant Feature Transform) is a computer vision feature detection technique for detecting and describing local features in pictures. Object recognition, robotic mapping and navigation, picture stitching, 3D modeling, gesture recognition, video tracking, individual animal identification, and match moving are some of the applications. Object SIFT keypoints are first retrieved and saved in a database from a collection of reference images. The pseudocode for scale-invariant feature transform is shown in Table 1. An item in a new picture is identified by comparing each feature in the new image to this database and discovering possible matching features based on the Euclidean distance between their feature vectors. Accuracy of Handwritten Character Recognition for SIFT is shown in Table 3.

$$G(x,y,\sigma) = \frac{1}{2\pi\sigma^2} e^{\frac{-(x-2+y-2)/2\sigma^2}{}} \quad (1)$$

In the SIFT descriptor, the dimensions estimate of a region round the interest purpose is set as a relentless times the detection scale s of the interest purpose, which might be actuated by the property of the dimensions choice mechanism within the interest purpose detector of returning a characteristic size estimate related to every interest purpose once computing the orientation bar graph, the increments area unit weighted by the gradient magnitude and conjointly weighted by a mathematician window perform targeted at the interest purpose and with its size proportional to the detection scale. To extend the accuracy of the orientation estimate, a rather dense sampling of the orientations is employed, with thirty six bins within the bar graph. Moreover, the position of the height is nationalized by local parabolic interpolation around the most purpose within the bar graph.Accuracy of Handwritten Character Recognition for SIFT is shown in Table 3.

Convolutional Neural Network (CNN)

The Convolutional Neural Network (CNN) are basic devices for profound learning, and are particularly suited for picture acknowledgment. Convolutional neural systems utilize pictures straightforwardly as information (Zuolin Shen, Xu, and Lu 2019). The convolution arranges plays out the capacities that are performed by cells in the visual cortex, for example, extricating basic visual elements like situated edges, end-focuses, corners, and so forth (Bhanu and Kumar 2017). Convolutional neural systems consist of convolutional layers which remove helpful data from the information and take out superfluous fluctuation (Labati, Piuri, and Scotti 2015). Each phase in a convolutional system is made out of a channel bank, and highlights pooling layers. Pseudocode for the SVM algorithm is shown in Table 2. With numerous stages, a convolutional system can learn multi-level chains of importance of elements. The accuracy for Convolutional neural networks is described in Table 4.

$$S[t] = (x \star w)[t] = \sum_{a=-\infty}^{a=\infty} x[a]\, w[a+t] \quad (2)$$

A Convolutional Neural Network (ConvNet/CNN) may be a Deep Learning formula which might soak up associate degree input image, assign importance (learnable weights and biases) to numerous aspects/objects within the image and be ready to differentiate one from the opposite. The pre-processing needed during a ConvNet is way lower as compared to different classification algorithms. whereas in primitive ways filters square measure hand-engineered, with enough coaching, ConvNets have the flexibility to find out these filters/characteristics. A ConvNet is in a position to with success capture the spatial and Temporal dependencies in a picture through the applying of relevant filters. The design performs an improved fitting to the image dataset because of the reduction within the range of parameters concerned and reusability of weights. In different words, the network is often trained to know the sophistication of the image higher.

STATISTICAL ANALYSIS

The minimum requirement to run the softwares used here are Intel core I3 dual core CPU@3.2 GHz, 4GB RAM, 64 bit OS, 1TB hard disk space personal computer and software specification includes Windows 8, 10, 11, Python 3.8 and MS-Office.

The Handwritten Character Recognition is predicted by the randomized method, a forest of

randomized trees is trained and the final prediction is based on the majority vote outcome from each tree. This method allows weak learners to correctly classify data points in an incremental approach that are usually misclassified.

Statistical package for the social sciences version 26 software tool was used for statistical analysis. An independent sample T-test was conducted for accuracy. Standard deviation, standard mean errors were also calculated using the SPSS software tool. The significance values of proposed and existing algorithms contains group statistical values of proposed and existing algorithms.

3. Results

In statistical tools, the total sample size used is 20. This data is used for the analysis of the Novel Scale-Invariant Feature Transform and Convolutional Neural Network. Statistical data analysis is done for both the prescribed algorithms namely Novel Scale-Invariant Feature Transform and Convolutional Neural Network. The group and accuracy values are being calculated for given systems. These 20 data samples used for each algorithm along with their loss are also used to calculate statistical values that can be used for comparison. Table 5, shows that group, accuracy, and loss values for two algorithms content-based Novel Scale-Invariant Feature Transform and Convolutional Neural Network are denoted. The Group statistics table shows the number of samples that are collected. Mean and the standard deviation is obtained and accuracies are calculated and entered. Table 2 shows the pseudocode for Convolutional Neural Network Classification. Table 4 shows the accuracy of Handwritten Character Recognition using Convolutional Neural Network.

Table 6, shows group statistics values along with mean, standard deviation and standard error mean for the two algorithms are also specified. Independent sample T-test is applied for data set fixing confidence interval as 95%. Table 7, shows independent t sample tests for algorithms. The comparative accuracy analysis, mean of loss between the two algorithms are specified. Figure 1, shows a comparison of the mean accuracy and means loss between content Novel Scale-Invariant Feature Transform and Convolutional Neural Network.

4. Discussion

From the results of this study, the Novel Open Scale Invariant Feature Transform is proved to be having better accuracy than the Convolutional Neural Network model. SIFT has an accuracy of 96.97% whereas CNN has an accuracy of 94.33%. The group statistical analysis on the two groups shows that Novel Open Scale Invariant Feature Transform has more mean accuracy than Convolutional Neural Network and the standard error mean including standard deviation mean is slightly less than Novel Open Scale Invariant Feature Transform.

Handwritten Character Recognition dataset was performed using Novel Open Scale invariant feature transform (Alom et al. 2018). Modulation based categorization which gave an accuracy of 96.97%. Attention based Handwritten Character Recognition paper provided an accuracy of 94.33%. Speech emotion recognition using automatic speech emotion recognition using SIFT has an accuracy of 96.97% (Jain and Lazzerini 2020). CNN using raw temporal data and datasets gave an accuracy of 94.33%. Our institution is zealous about high quality proof based research and has excelled in various fields (Ding 2012). Handwritten Character Recognition for the dataset was performed using Novel Open Scale invariant feature transform modulation based categorization which gave an accuracy of 96.97% (Wang 1991). Attention based Handwritten Character Recognition paper provided an accuracy of 94.33% (Jalali, Kavuri, and Lee 2021).

The limitation in this model is that the accuracy of SIFT may get affected due to the inconsistent data and difficulty in getting the right datasets for analysis. Most of the data is simulated from nature which is far from reality. Effective data preprocessing techniques and the combination of SIFT with other machine learning algorithms such as CNN and SIFT may give better accurate results in the future.

5. Conclusion

Based on the experimental results, the Novel Open Scale Invariant Feature Transform (SIFT) has been proved to predict Handwritten Character more significantly than Convolutional Neural Network (CNN). It can be used in predicting the Handwritten Character in the Future. Hence, it is inferred that the Novel Open Scale Invariant Feature Transform (SIFT) appears to be better in accuracy when compared to the Convolutional Neural Network.

Declarations

Author Contributions

Author KK was involved in data collection, data analysis, data extraction, manuscript writing.

Author SC involved in conceptualization, data validation and critical review of the manuscript.

Acknowledgement

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. Vee Eee Technologies Solution Pvt. Ltd.
2. Saveetha University.
3. Saveetha Institute of Medical and Technical Sciences.
4. Saveetha School of Engineering.

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TABLES AND FIGURES

Table 1. Pseudocode for Novel Open Scale Invariant Feature Transform

INPUT: Dataset Records
1. Import the required packages.
2. Convert the image into machine readable after the extraction feature.
3. Assign the image to the output variables.
4. Using the model function, assign it to the variables.
5. Compiling the model using metrics as accuracy.
6. Evaluate the output
7. Get the accuracy of the model.
OUTPUT : Enhanced Accuracy in Handwritten Character

Table 2. Pseudocode for Convolutional Neural Network

INPUT: Dataset Records
1. Read and test data for enhancement for handwritten images
2. Extract handwritten character attributes for enhancement
3. Extract attributes to enhance handwritten character data
4. Input handwritten image
5. Apply Convolutional Neural Network
6. Learn user preferences

7. Return accuracy
OUTPUT : Enhanced Accuracy in Handwritten Character

Table 3. Accuracy of Handwritten Character Recognition using SIFT

Test size	**Accuracy**
Test 1	96.97
Test 2	95.40
Test 3	95.10
Test 4	94.80
Test 5	94.44
Test 6	94.00
Test 7	93.86
Test 8	93.17
Test 9	92.86
Test 10	92.44

Table 4. Accuracy of Handwritten Character Recognition using CNN

Test size	**Accuracy**
Test 1	94.33
Test 2	94.00
Test 3	93.75
Test 4	93.42
Test 5	92.88
Test 6	92.55
Test 7	92.00
Test 8	91.45
Test 9	91.11
Test 10	89.66

Table 5. Group, Accuracy and Loss value uses 8 columns with 8 width data for HandWritten Character Recognition.

SI.NO	Name	Type	Width	Decimal	Columns	Measure	Role
1	Group	Numeric	8	2	8	Nominal	Input
2	Accuracy	Numeric	8	2	8	Scale	Input
3	Loss	Numeric	8	2	8	Scale	Input

Table 6. Group Statistic analysis, representing Novel Open Scale Invariant Feature Transform and Convolutional Neural Network

	Group	N	Mean	Std Deviation	Std.Error Mean
Accuracy	SIFT	10	94.3040	1.34751	.42612
	CNN	10	92.5150	1.47206	.46551
Loss	SIFT	10	5.6960	1.34751	.42612
	CNN	10	7.4850	1.47206	.46551

Table 7. Independent Sample Tests results with confidence interval as 95% and level of significance as 0.05 (Open Scale Invariant Feature Transform appears to perform significantly better than Convolutional Neural Network with the value of p=0.179)

		Levene's Test for Equality of variance		T-Test for equality of mean						
				t	df	Sig(2-tailed)	Mean difference	Std. Error Difference	95% confidence of Difference	
		F	Sig						Lower	Upper
Accuracy	**Equal variances assumed**	.133	.179	2.835	18	.011	1.78900	0.63109	0.46313	3.11487
	Equal Variances not assumed	-	-	2.835	17.861	.011	1.78900	0.63109	0.46239	3.11561
	Equal variances assumed	.133	.179	-.2.835	18	.011	-1.78900	0.63109	-3.11487	-0.46313

Loss										
	Equal Variances not assumed	-	-	-2.835	17.861	.011	-1.78900	0.63109	-3.11561	-0.46239

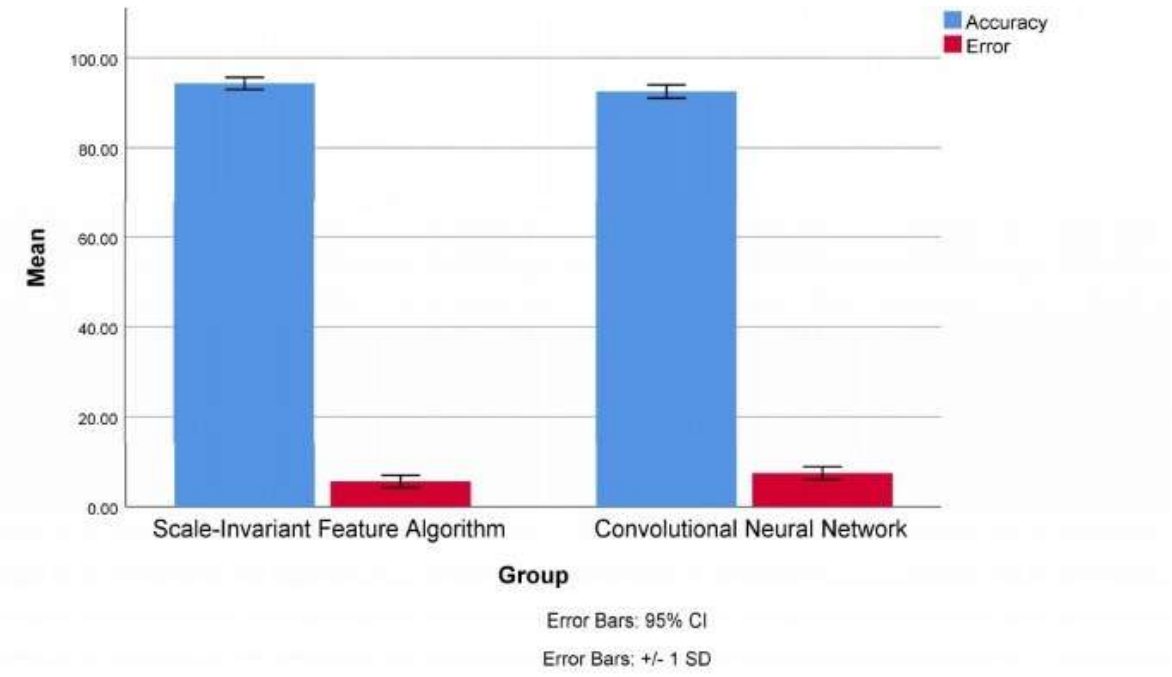

Fig. 1. Comparison of Novel Open Scale Invariant Feature Transform and Convolutional Neural Network in terms of accuracy. The mean accuracy of Novel Open Scale Invariant Feature Transform is greater than Convolutional Neural Network and the standard deviation is also slightly higher than Convolutional Neural Network. X-axis: Novel Open Scale Invariant Feature Transform vs Convolutional Neural Network. Y-axis: Mean accuracy of detection + 1 SD.