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MARATHI HANDWRITTEN CHARACTER RECOGNITION USING CNN

Shreyas Honrao, Vaishnavi Parkhi, Apurva Kate, Shubham Sonawane, Dr Amrapali Chavan

ALL INDIA SHRI SHIVAJI MEMORIAL SOCIETY
INSTITUTE OF INFORMATION TECHNOLOGY
PUNE, MAHARASHTRA

Abstract: In this article, we demonstrate how deep learning was used to implement handwritten character recognition in Marathi. Because of its significant contribution to automation systems, handwritten character recognition is becoming more important. One of the several language scripts used in India is the Devanagari script. There are 12 vowels and 36 consonants in it. Here, we used a deep learning model to implement character recognition. Pre-processing, segmentation, feature extraction, prediction, and post-processing are the five main phases in character recognition. To train the model and employ character recognition and anticipate the accuracy of recognition, the model will make use of convolutional neural networks and image processing techniques.

Keywords: Pre-processing, Segmentation, Classification, Convolutional Neural Network, Deep Learning, Devanagari Character Recognition.

I. INTRODUCTION

Deep convolutional neural networks have been tested on a variety of issues using a hierarchical architecture, countless parameters, and learning from enormous databases. Convolutional neural networks (CNNs) are a subclass of deep neural networks that are particularly well-suited for image or video processing, type recognition, and sample reputation. They are composed of several convolutions, pooling layers, and fully linked layers. In recent years, CNN has drawn attention for achieving cutting-edge results in a variety of laptop vision applications, including the pharmaceutical, aerospace, natural language processing, and robotics industries. High computing costs for information processing and determining the best CNN architecture parameters are just two of the difficulties we confront when designing the CNN architecture. There are other difficulties we confront, such as the high computational cost of processing information and determining the best CNN architecture settings. Many academics have used the ideal CNN design to improve performance in order to tackle this issue.

DEVANAGARI SCRIPT

The most widely used script in India is Devanagari, which is used for languages including Sanskrit, Marathi, and Hindi. There are 36 consonants and 12 vowels in the Devanagari alphabet.

क	ख	ग	घ	ङ	च	छ	ज	झ	ञ	ट	ठ	ड	ढ	ण
त	थ	द	ध	न	प	फ	ब	भ	म	य	र	ल	व	श
ष	स	ह	ळ	क्ष	ज्ञ									

Table 1: Basic consonants in Devanagari

अ	आ	इ	ई	उ	ऊ	ए	ऐ	ओ	औ	अं	अः	ॲ	ऑ	ऋ

Table 2: Basic vowels in Devanagari.

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II. LITERATURE SURVEY

[1] The authors of the paper [1] used KNN and SVM to accomplish Marathi handwritten character classification. The dataset utilised includes every Marathi character as well as several writing styemes.The input dataset is the Kaggle dataset. The canny approach is used to detect edges. Next, undesired portions are removed and filled in using morphological procedures. Characters are then cropped using the bounding box technique, and the image is then normalised. By detecting the direction and gradient of the pixel using the Sobel filter, the HOG method is used to extract the feature vectors from the pre-processed image.

[2]Rectangle Histogram Oriented Gradient [R-HOG] was employed by the authors of study [2] for feature extraction, while feed-forward artificial neural networks (FFANN) and support vector machines (SVM) with radial basis functions (RBF) were utilised for classification. Noise reduction, edge detection, patching together of tiny broken letters, normalisation, region filling, and segmentation are the key pre-processing goals utilised here. The bounding box is used to segment the data. Before being transmitted for normalisation, the characters that have been split are further chopped. In order to conduct the experiment, MATLAB 8.0 is used.

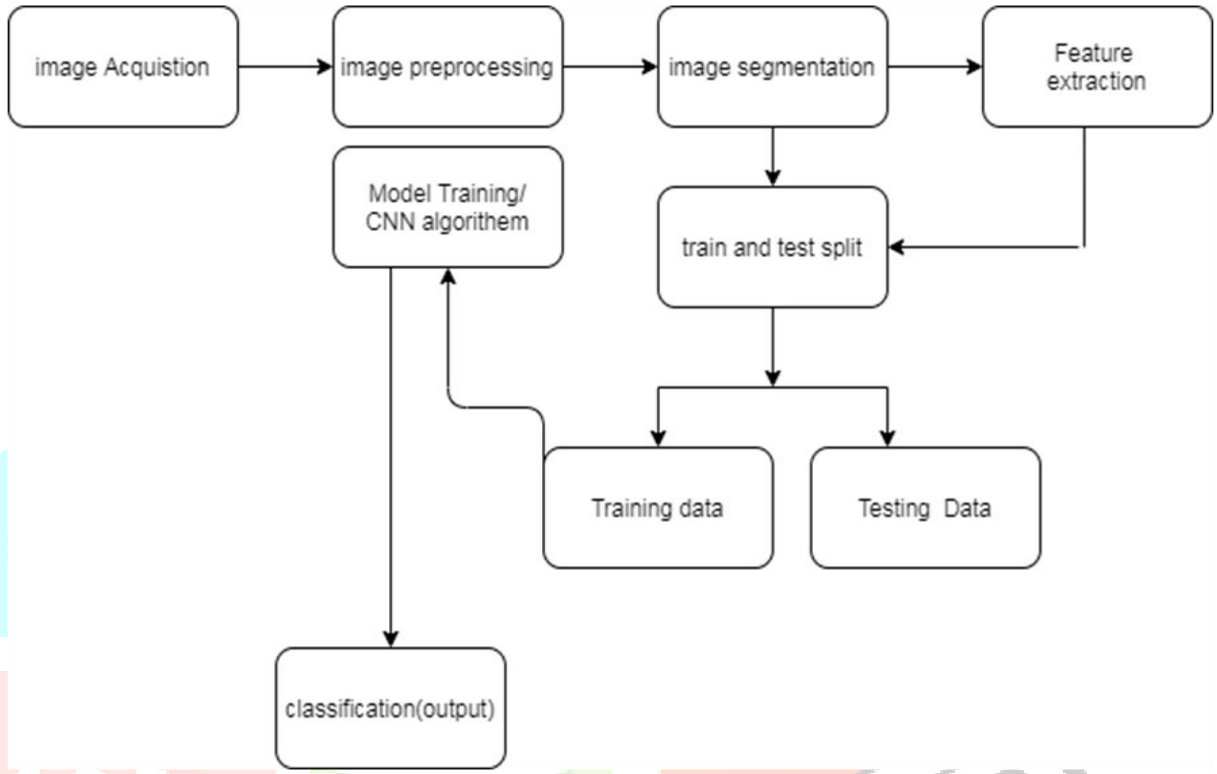
[3] In paper [3], authors used SVM with the linear kernel as a classifier and K-Means Clustering as a feature extraction technique to recognise handwritten Hindi characters. Binarization, morphological procedures to remove the horizontal bar, feature extraction, and classification are used as preprocessing steps. Implementation is performed using MATLAB. The Hindi word input dataset is provided as the input. After being removed from the word, the characters are scaled to 70x50 pixels. There are seven horizontal segments in this enlarged binary picture.Each portion is subjected to K-means clustering, with the 5 centroids supplied. K-means clustering is used to extract a vector containing 35 values from the image. Each character has a set of feature vectors. The results of classification using the Support Vector Machine (SVM) and the Euclidean distance method are contrasted.

III. RESEARCH METHODOLOGY

Our recommended mechanism should achieve the following goals: Deep convolutional neural networks have surpassed standard shallow networks in a number of recognition tests. We explore the application of alternate architecture and methodology for character recognition in contrast to Deep CNN's conventional approach. to describe the design of the proposed method and algorithms. to describe the suggested algorithms for practical analysis and determine how effective they are. to evaluate and contrast the recommended and existing methods in order to increase the precision of character identification. Information on studying Marathi Devanagari script is provided in this section. After choosing the dimension, ten writers and twenty-four alphabets' worth of handwritten characters (10 writers, 24 alphabets, 10 per alphabet) were recorded. The total database size was 2400. We used a total of 2000 data sets after removing noisy data and photos that were not associated with the established parameter alphabets. For recording the handwritten characters, which have a 32x32 dimension each, we used the MS Paint application. The photos have an 8bpp grey level. We carefully account for rotation and shift while recording. Then, each image was normalised by a value of 255 to have a dynamic range of 0–1. The NN we take into account is a dense network with 1024 input nodes, two hidden layers, and a final output layer of 24. (number of alphabets). Relu is the activation for the hidden layer, and Tanh is the output activation. To avoid data overfitting, we additionally added a 10% dropout for each layer. For input during training, each normalised alphabet image is reduced to a single vector of 1024 pixels. A vector with a single hot representation and a size of 24 is the relevant output. Adam was employed as the optimizer during training with a loss function of binary cross entropy and a learning rate of 0.0001. We split the data in half, 80:20 each for training and validation. Network training is carried out over 500 epochs in batches of 8 epochs. Throughout testing, we follow the same process and select the predicted alphabet by using the max operator on the output probabilities. Many types of information that were formerly saved on paper are being converted to electronic form for better storage and more intelligent processing. Document representation as images is unsatisfactory because the user is unable to edit or review the document. We have decided to concentrate our research on the development of OCR systems because there are so many potential applications for them in business and industry. A computer can read text from a photograph using a technology called OCR. Digitalizing printed text is necessary so that it may be read electronically, stored compactly, or applied to automated processes like translation or text-to-speech conversion. The numerous training layers and the ideal result will be taken into account. Layer dropout: Use an average dropout rate of 15%–30% of neurons, with 15% being a good place to start. A probability that is too high inhibits the network from learning enough, while one that is too low has little effect. When dropouts are used on a larger network, the model has a greater chance of learning independent representations, which is likely to result in the best performance. We have had success using dropout on incoming (visible) as well as concealed units at each tier of the network. Utilise a high momentum and decay with a high learning rate. Increase your learning rate by a factor of 15 to 100 by using a high momentum value of 0.9 or 0.99. restrict the network's weights' size. With a high learning rate, very large network weights can be generated. A restriction on the size of network weights, such as maxnorm regularisation with a size of 4 or 5, has been shown to improve results. Thick Layer: A dense layer in a convolution neural network is only an additional layer of standard neurons. The layer of closely connected neurons that comes before each neuron provides input. Along with a bias vector b and a weight matrix W, the activations from the layer a layer before it are also present. Symbolising the multiplication of matrix vectors is a dense layer. The values in the matrix correspond to the trainable parameters that are updated during back propagation if your batch size is 1 (assumed). T.W., W. Rnmu, W. Rnxm, and uT.W. The output is an m-dimensional vector as a

result. Therefore, using a dense layer is necessary to change the vector's dimensions. Your vector is mathematically transformed by being translated, scaled, and rotate

IV. SYSTEM ARCHITECTURE



Building a system for recognising handwritten Marathi Devanagari script is the aim of this research, which aims to develop a computationally efficient segmentation approach. Optical character recognition is not a one-step process in its entirety. It starts with preprocessing and ends with classification and recognition stages, as seen in the image. Our study's objective being the offline recognition of Devanagari texts, we have gathered data in the form of handwritten documents made using any colour pen. The first step is to convert handwritten content into an editable format. The fact that the data could be in a variety of formats means that we don't need to worry about its type. One may, however, take into account having more control over the data being collected as technology develops. We can pick our favourite texturing format, and the finished work is available in notepad or doc format.

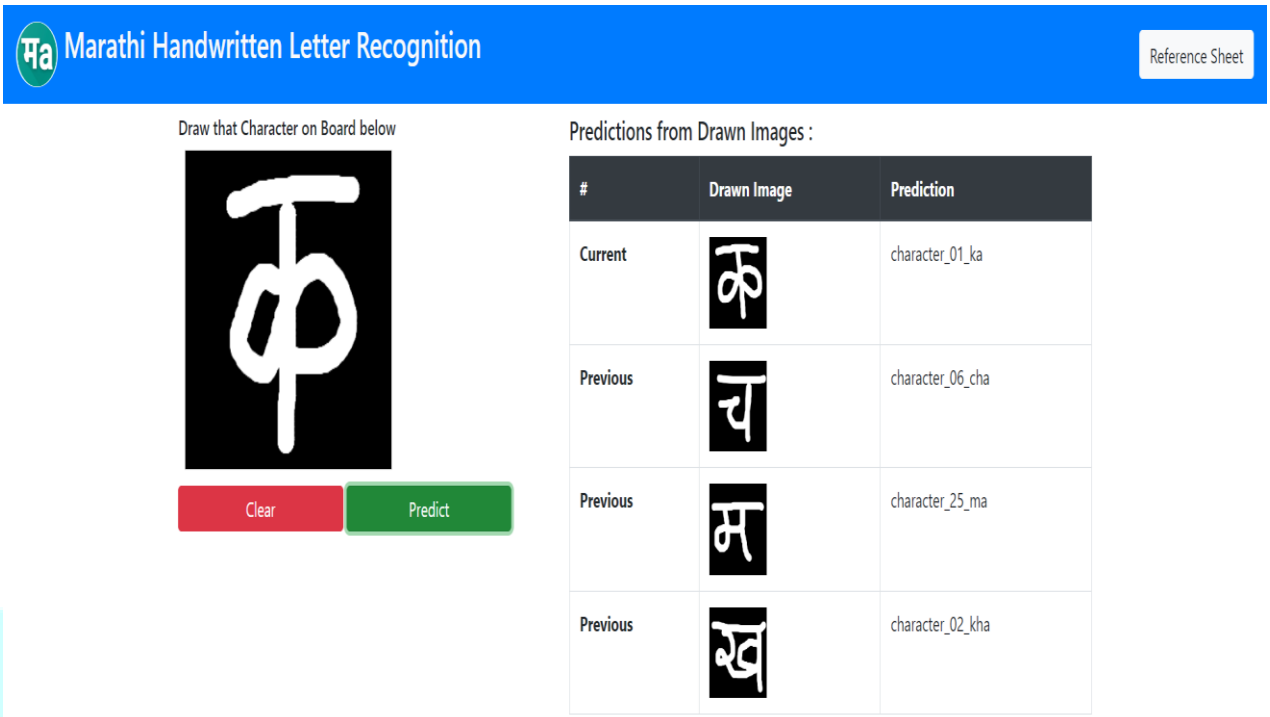
V. ALGORITHM

Deep artificial neural networks called convolutional neural networks are typically used to classify photos (e.g., label what they see), group them together based on similarities (photo search), and recognise objects in situations. These algorithms are capable of recognising a wide range of visual data, including faces,

people, street signs, cancers, platypuses, and many others. One of the key factors that has caused the world to realise the effectiveness of deep learning is the effectiveness of convolutional networks (also known as CNNs or ConvNets) in image recognition. They are driving significant developments in computer vision (CV), which has obvious uses in robotics, drones, security, and the diagnosis and treatment of blindness. Convolutional, pooling, flattening, dense, and

dropout layers make up the convolutional neural network. In the convolutional layer, the convolutional procedures are carried out. To get around the issues with overfitting, employ the dropout layer.

VI. RESULT AND OUTPUT



VII. CONCLUSION

Due to the wide range of potential applications, the recognition of handwritten characters has been a well-liked study topic for many years.We introduced the Devnagari Character Dataset, a brand-new dataset that is freely accessible to all researchers. It contains 92 thousand photos of 46 different Devnagari script characters. With the Devnagari Dataset, we looked at the difficulties in character classification. The difficulties arise from the dataset's large number of characters, many of which are aesthetically similar or are typically spelled in similar ways. Moreover, the base form of consonant characters in Devnagari script can be joined with vowels to generate extra characters; however, this combination is not examined in this study. We suggested two deep learning models to train the dataset for recognition. In order to avoid these networks becoming overfit, we also looked at the impact of dropout layers and dataset increment. According to the experimental findings, Deep CNNs with a Dropout layer and Dataset Increment Technique can produce extremely high test accuracy even for a complex and varied dataset like ours.

REFERENCES

[1] Chikmurge, D., Shriram, R. (2021). Marathi Handwritten Character Recognition Using SVM and KNN Classifier. In: Abraham, A., Shandilya, S., Garcia-Hernandez, L., Varela, M. (eds) Hybrid Intelligent Systems. HIS 2019. Advances in Intelligent Systems and Computing, vol 1179.

[2] Parshuram M. Kamble, Ravindra S. Hegadi, Handwritten Marathi Character Recognition Using R-HOG Feature, Procedia Computer Science, Volume 45, 2015, Pages 266-274, ISSN 1877-0509.

[3] A. Gaur and S. Yadav, "Handwritten Hindi character recognition using k-means clustering and SVM," 2015 4th International Symposium on Emerging Trends and Technologies in Libraries and Information Services, 2015

[4] V. J. Dongre and V. H. Mankar, "A review of research on devnagari character recognition," arXiv preprint arXiv:1101.2491, 2011.

[5] Gurav, Yash et al. "Devnagari Handwritten Character Recognition using Convolutional NeuralNetworks." 2020 International Conference on Electrical, Communication ,and Computer Engineering(ICECCE). IEEE,2020

[6] J.-B. Yang, K.-Q. Shen, C.-J. Ong, and X.-P. Li, "Feature selection for mlp neural network: The use of random permutation of probabilistic outputs," Neural Networks, IEEE Transactions on, vol. 20, no. 12, pp. 1911–1922, 2009.

[7] H. Lee, R. Grosse, R. Ranganath, and A. Y. Ng, "Convolutional deep belief networks for scalable unsupervised learning of hierarchical representations," in Proceedings of the 26th Annual International Conference on Machine Learning. ACM, 2009, pp. 609–616.

[8] Y. LeCun, L. Bottou, Y. Bengio, and P. Haffner, "Gradient-based learning applied to document recognition," Proceedings of the IEEE, vol. 86, no. 11, pp. 2278–2324, 1998.

[9] A. Krizhevsky, I. Sutskever, and G. E. Hinton, "Imagenet classification with deep convolutional neural networks," in Advances in neural information processing systems, 2012, pp. 1097–1105.

[10] B. B. Le Cun, J. S. Denker, D. Henderson, R. E. Howard, W. Hubbard, and L. D. Jackel, "Handwritten digit recognition with a backpropagation network," in Advances in neural information processing systems. Citeseer, 1990.

[11] O. Abdel-Hamid, A.-r. Mohamed, H. Jiang, and G. Penn, "Applying convolutional neural networks concepts to hybrid nn-hmm model for speech recognition," in Acoustics, Speech and Signal Processing (ICASSP), 2012 IEEE International Conference on. IEEE, 2012, pp. 4277–4280.

[12] T. N. Sainath, A.-r. Mohamed, B. Kingsbury, and B. Ramabhadran, "Deep convolutional neural networks for lvcsr," in Acoustics, Speech and Signal Processing (ICASSP), 2013 IEEE International Conference on. IEEE, 2013, pp. 8614–8618.

[13] H. Larochelle, Y. Bengio, J. Louradour, and P. Lamblin, "Exploring strategies for training deep neural networks," The Journal of Machine Learning Research, vol. 10, pp. 1–40, 2009.

[14] Kamble, Parshuram M., and Ravindra S. Hegadi "Handwritten Marathi basic character recognition using the statistical method.". Emerging Research in Computing, Information, Communication, and Applications 3 (2014)

[15] Murthy, OV Ramana, and M. Hanmandlu."Zoning based Devanagari character recognition." International Journal of Computer Applications 27.4 (2011): 21-25.

[16] Arora, Sandhya, et al " A two-stage classification approach for handwritten Devnagari characters." International Conference on Computational Intelligence and Multimedia Applications (ICCIMA 2007). Vol. 2. IEEE, 2007.

[17] Deshpande, Parag S., Latesh G. Malik, and Sandhya Arora. "Fine Classification and Recognition of Hand Written Devnagari Characters with Regular Expressions and Minimum Edit Distance Method." JCP 3.5 (2008): 11-17.

[18] Hanmandlu, Madasu, OV Ramana Murthy, and Vamsi Krishna Madasu "Fuzzy Model-based recognition of handwritten Hindi characters.". 9th Biennial Conference of the Australian Pattern Recognition Society on Digital Image Computing Techniques and Applications (DICTA 2007). IEEE, 2007.

[19] Borse, Sunita B., Madhuri Bhalekar, and M. U. Kharat. "Handwritten character recognition with optimal zoning using GA."

[20] Pal, Umapada, et "Off-line handwritten character recognition of Devanagari script "alNinth International Conference on Document Analysis and Recognition (ICDAR 2007). Vol. 1. IEEE, 2007.

[21] Arora, Sandhya, et al."Recognition of non-compound handwritten Devanagari characters using a combination of mlp and minimum edit distance." arXiv preprint arXiv:1006.5908(2010).

[22] Sharma, Nabin, et al."Recognition of off-line handwritten Devanagari characters using the quadratic classifier." Computer Vision, Graphics and Image Processing. Springer, Berlin, Heidelberg, 2006. 805-816.

[23] Minakshi Sanjay Bhandare and Anuradha Sopan Kakade."Handwritten (Marathi) compound character recognition." 2015 International Conference on Innovations in Information Embedded and Communication Systems (ICIIECS). IEEE, 2015.

[24]" Kadhm, Mustafa S., and Asst Prof Dr. Alia Karim Abdul. "Handwriting word recognition based on SVM classifier International Journal of Advanced Computer Science and Applications 1 (2015): 64- 68.

[25] Kale, Karbhari V. "Zernike moment feature extraction for handwritten Devanagari (Marathi) compound character recognition." (2014).

[26] Vijayaraghavan, Prashanth, and Misha Sra."Handwritten tamil recognition using a convolutional neural network." (2014).

[27] Ramteke, Ashwin S., and Milind E. Rane. "Offline handwritten Devanagari script segmentation." International Journal of Scientific and Technology Research 1.4 (2012): 142-145.

[28] Dhandra, B. V., Gururaj Mukarambi, and Mallikarjun Hangarge."Zonebased features for handwritten and printed mixed Kannada digits recognition." IJCA Proceedings on International Conference on VLSI, Communications, and Instrumentation (ICVCI). No. 7. 2011.

[29] Shelke, Sushama, and Shaila Apte."A multistage handwritten Marathi compound character recognition scheme using neural networks and wavelet features." International Journal of Signal Processing, Image Processing and Pattern Recognition 4.1 (2011): 81-94. [30] Ajmire, P. E., R. V. Dharaskar, and V. M. Thakare."Handwritten Devanagari (Marathi) compound character recognition using seventh central moment." International Journal of Innovative Research in Computer and Communication Engineering 3.6 (2015).