Applied Computer Science, vol. 17, no. 2, pp. 90–99
doi: 10.23743/acs-2021-15

Submitted: 2021-05-13 | Revised: 2021-06-14 | Accepted: 2021-06-20

Deep Convolution Network, Tamil Letter,
Recognition System, Font Recognition, Filtering

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RECOGNITION OF FONT AND TAMIL LETTER IN IMAGES USING DEEP LEARNING

Abstract

This paper proposes a deep learning approach to recognize Tamil Letter from images which contains text. This is recognition process, the text in the images are divided to letter or characters. Each recognized letters are sending to recognition system and filter the text using deep learning algorithms. Our proposed algorithm is used to separate letter from the text using convolution neural network approach. The filtering system is used for identifying font based on that letters are found. The Tamil letters are test data and loaded in recognition systems. The trained data are input which contains filtered letter from image. For example, Tamil letters such as are available in test dataset. The trained data are applied into deep convolution neural network process. The two dataset are created which contains test data with Tamil letter and second one for recognized input data or trained data. 15 thousands of letters are taken and 512 X 512 X 3 size deep convolution network is created with font and letters. As the result, 85% Tamil letters are recognized and 82% are tested using font. TensorFlow is used for testing the accuracy and success rate.

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1. INTRODUCTION

Current scenario automation is mandatory for all process including online ordering, ticketing, emailing, etc,. In Digital era intelligent applications are played vital role and different applications. Creating intelligent application means machine learning and deep learning processes are more important for data processing and analytics (Sevik, Erdogmus & Yalein, 2018). Many researchers are doing research on deep learning in different application such as medical imaging, automation, banking and IoT. Deep learning is neural network approach and follow the mechanism of decision tree approach. This is hierarchical approach to simulate input data. For example, human brain input are sensed and created deep belief representation for simulation (Manikandan & Chinnadurai, 2019).

In 2005, perception approach is suggested for analyzing neural network system in digital applications. This is a recommendation system and multiple layers are created for making effective decisions (Adomavicius & Tuzhilin, 2018). Industry 4.0 standards intelligent decision making and automated modelling are important in today's IT and ITeS (Bati, 2014).

The various studies are going for deep convolution neural network model. The given or sensed images are taken for analyzing process and set of algorithms are used to make effective decisions (Jaiem, Slimane & Kherallah, 2017). The natural language processing is important for nowadays for processing different languages. So deep learning method is very useful for finding input of various natural language data through that will take effective decisions (Eltiez, 2015).The deep learning model is very useful for finding patterns, edges, decision making, data analytics and recognizing the objects, text, characters, etc, from input images (Koyun & Afsin, 2017). It is feature extraction process so the input image data are directly taken for classification and clustering operations.

This is a process to eliminate redundant data and extract needy information. This is multilayer model and each layer is considered for evaluations in two dimensional planes (Manikandan & Chinnadurai, 2020, Manikandan et al., 2020, 2021; Tajmir & Alkasab, 2018). It has three section input, hidden and output section. The input layer is recognizing layer and getting sensed input from different environments. Hidden layer is machine learning layer for converting 0 and 1 value for data processing. Output layer is decision making layer for prediction, classification or regression (Sathiyamoorthi, 2016).

The convolution neural network is a classification process which contains set of classes and perceptions. Learning system consists of supervised and unsupervised learning methods. Supervised learning system is used for knowing input and output pairs for example clustering, decision support systems (Zhou & Tuzel, 2017). Unsupervised learning is used for unknown input and output pairs such as social media data, data logs, etc. This is fully connected layer and this method is proposed for system to recognize the Tamil letters. This papers describes various sections, section 2 explain various related works, section 3 described deep convolution process, section 4 gives experimental results and section 5 explains conclusion and future process.

2. RELATED WORKS

In past years, deep learning is playing important role for making effective decision making capabilities. Lot of researches are going for prediction, decision making, data analytics and recommendations using deep learning (Mainkandan & Chinnadurai, 2019). Wong et al, suggested deep learning is a subset of machine learning to predict intelligent data analytics process from set of trained data. Manikandan et al, explain TensorFlow is the simulation tool for processing deep convolution operations. Deep learning is used for predicting food ordering applications, video dataset processing, educational sciences, online learning environments and image annotation applications (Yuan, Mou & Lu, 2017).

The convolution neural network is proposed for handling big data, unsolved problems, unstructured data, ambiguous dataset, No SQL dataset and decision making applications. For handling image and video processing applications means deep learning is important for classification and prediction operations suggested by Yung et al. This is successful diagnostics method for all the data analytics processing. Aylin et al, provides deep learning method is used for recognizing letters from images using font and size. Recognition is process of extracting data from digitized input contents.

Nowadays digital information are contains images and text so extracting text from images means we need effective decision making system. Previously Rugny et al, proposed optical character recognition system is used for fining text from barcode images. Currently quick response code is used for accessing web data (Shanthi & Sabeenian, 2019). But the problem each data are structured and 20X20 pixel data. Now we are using natural language input data with unstructured dataset. So we are in need of multiple convolution neural network models for predicting characters.

Some researchers are doing research on Font recognition based on identified characters and letters. For example, Arabic, Turkish, Chinese and Korean letters are identified by using Font. Based on above related studies we are taking font and character wise recognition system for recognizing Tamil letter using TensorFlow. TensorFlow is a open source simulating tool which developed by Google for processing deep learning applications. Our proposed algorithm is tested by using TensorFlow.

3. RECOGNITION SYSTEM

Based on different studies and literatures, the hand written letters are analyzed and recognized in different languages. Commercially many applications are used for handling hand written input data processing. Turkish letters are identified by using deep learning process from set of images. In our proposed method we would take deep learning method to recognize font and Tamil Letter in images. Our system proposes capture the image and apply deep convolution neural network to extract letters.

In this method we took recognize Tamil letters and font based recognition system. The proposed algorithm is developed for identifying Tamil Letters. First step the pre-processing of input dataset, second step convolution process is taken and third step letters to be identified.

3.1. Dataset and Data Pre-processing

Here we used two dataset such as trained data as input data or recognizing data, second one is test data which is consists of pre-trained data or Tamil letters data set. The test data consists of 256 Tamil Letters and 6 Tamil fonts totally 1536 letters are pre-trained and loaded into our applications. Our system has font size minimum of 7, maximum of 72 and medium of 30 points. Input data is trained data which is applied into 512 × 512 × 3 layer deep convolution neural network process. So we can process 786432 letters can be processed and compared with 1536 test dataset. The sample image dataset are shown in below.

Fig. 1. Tamil Letters dataset

3.2. Deep Belief Network

Based on input dataset, the deep belief network is created by using TensorFlow. In TensorFlow, Alexnet model is trained to classify more than 1000 of images and obtained 25 layers learning systems. The dataset can be divided into trained data and test data. 85 percentage of images are taken from trained data after applying deep learning process. Deep learning process is consisting of two phases such as supervised and unsupervised learning. In supervised learning the data is taken and applying classification and regression for eliminating redundant data. While unsupervised learning means the supervised learning resultant data is taken and applying classification for prediction.

The 256 letters of Tamil and 6 Tamil fonts are testing dataset and created 25-layer Alexnet for pre-processing. Once pre-processing done the trained dataset is applying for learning process. The learning process scheme is shown in below.

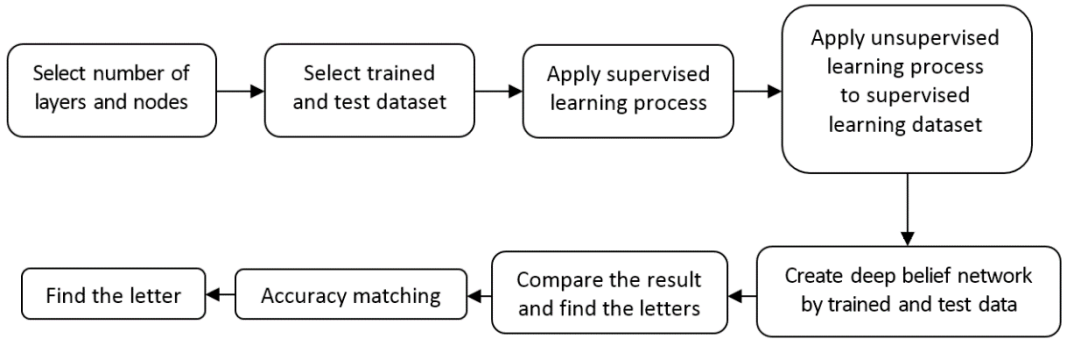

Fig. 2. Learning Process – Deep Belief Network

4. PROCESSING SYSTEM

Learning system is initiating this process, set of image(s) are taken into account and apply the following pre-processing steps

Step 1: Images are converted into grayscale format. It is called as intensity mapping to identify computer understandable or processing format

Step 2: Apply Morphological process for removing or eliminating noises, unwanted letters and characters

Step 3: Apply Matrix operation to select object location using horizontal, vertical and diagonal values

Step 4: 8 × 8 decision tree matrix is created with connected components. This stage each letter is identified and located.

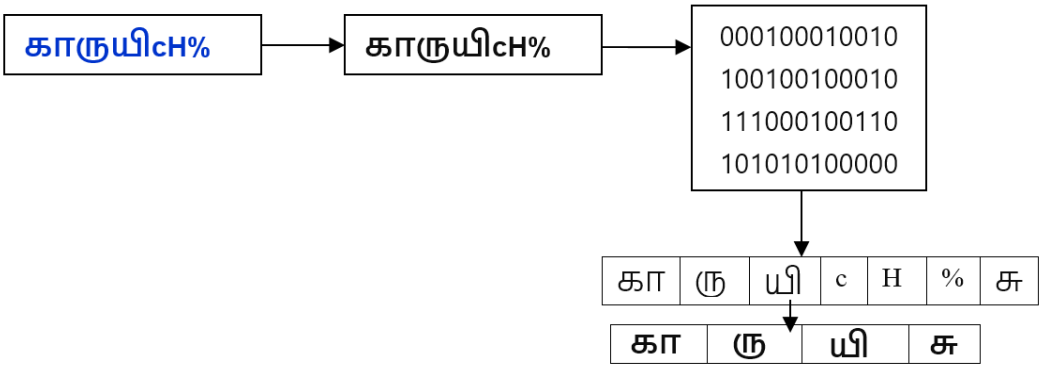

Fig. 3. Processing and Letter Identification

5. 5. DEEP LEARNING – PROCESS

After pre-processing, the letters are separated and labelling completed. The deep learning process step are:

Step 1: The label values are selected and stored in trained dataset.

Step 2: Apply proportional calculation to select labelled imaged.

Let $\{a, b\}$ set of input pair values, N – Number of nodes available in matrix, (i, j) – coordinate position, l – labelling point, proportional point (p):

$$(p) = \frac{1}{N}\sum_{i=0,j=0}^{N-1}\frac{(ai,bj)}{N} \tag{1}$$

Step 3: The letter has to be separated and labelled based on Proportional point like symbols, English and other.

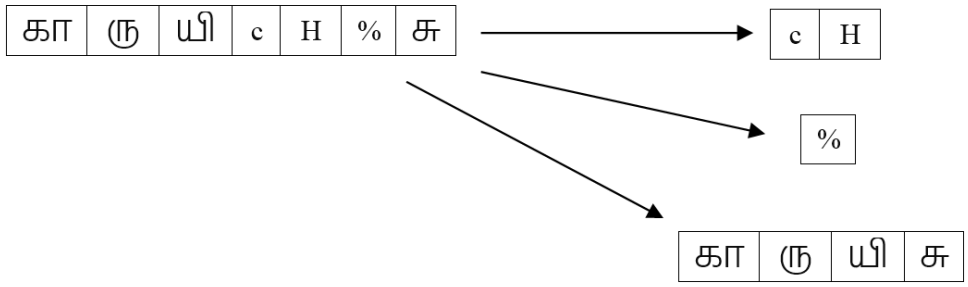

Fig. 4. Labelling process and Elimination Selection

Step 4: Based on this Symbol and English characters are eliminated and other dataset is stored for further process

Step 5: The stored dataset as trained dataset and created 512 × 512 × 3 size deep convolution network

Step 6: Each letter are sending to learning system and label input, output and hidden values

Step 7: The below layered process is taken for selecting each character and hidden operations – Hidden Value $(h_{(i,j)})$:

$$\left(h_{(i,j)}\right) = \begin{cases} 0, \ i = j = 0 \\ 1, \ i = j = N-1 \\ \sum_{i=0,j=0}^{N-1}\frac{(a(i),b(j)\cdot(a(j),b(i))}{N}, i = j = 1,2,\ldots,N-2 \end{cases} \tag{2}$$

Step 8: After selecting hidden values the test dataset is selected and compare the result. Each letter compared and select the Tamil letters. Same process will be continued until process will stops. The accuracy factor is obtained as accuracy rate $(A_{\%})$:

$$(A_{\%}) = \sum_{i=0,j=0}^{N-1}\frac{(a(i,j)\cdot b(i,j)}{h(i,j)^N} \tag{3}$$

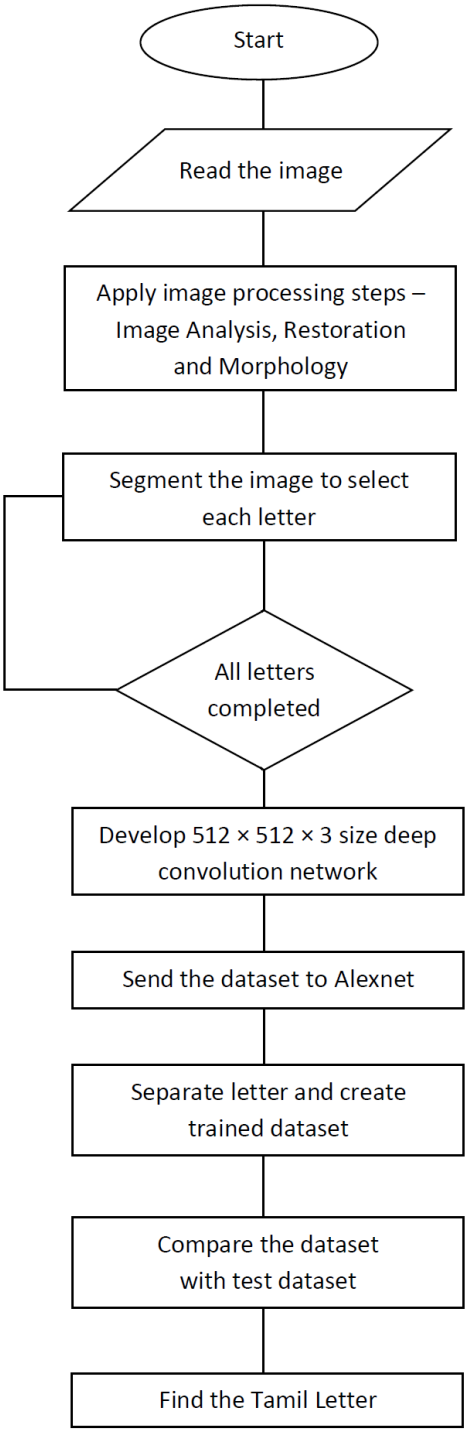

Fig. 5. Flowchart – Deep Learning Process

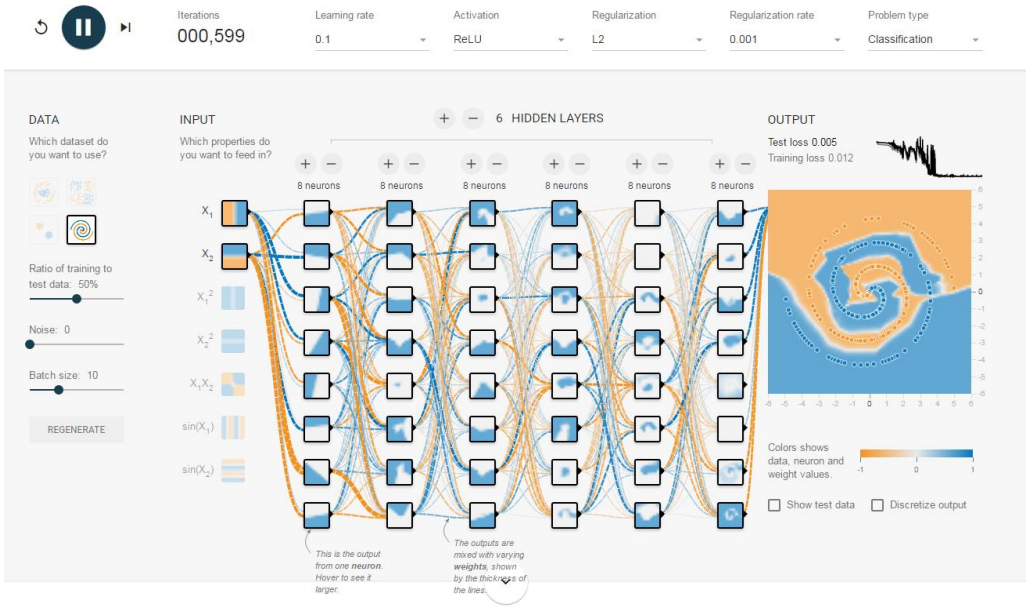

Fig. 6. Deep Belief Network with input, output and hidden layers results from TensorFlow

The above figure shows that generated deep belief network from TensorFlow with 512 × 512 × 3 size deep convolution network operations. Here the trained dataset are applied and compare the result with test dataset. The below table 1 shows training result and separation of letters using TensorFlow.

Tab. 1. Learning rate result based on segmentation

Epoch	Iteration	Time taken (in ms)	Accuracy	Loss	Elimination factor	Proportional point (%)
1	1	25	1.75	0.85	2.75	82
2	5	35	1.85	0.87	2.85	83
3	10	45	1.97	0.86	2.25	85
4	15	58	1.85	0.92	2.75	86
5	20	115	2.02	0.86	2.65	89
6	25	135	2.75	0.85	2.89	92
7	30	145	2.85	1.05	2.91	87
8	35	205	1.98	0.92	2.75	85
9	40	275	2.75	0.87	2.88	83
10	45	315	1.98	0.87	2.81	82

The accuracy factor is calculated based on Proportional point and learning rate.

Tab. 2. Deep learned result – Tamil Letter Identification

தABமி&*ழ்HJiKவாf325க்gfj919கிய() 453””ங்??/8 க76438ள்698 4^$%Q^பு&*$#*த்த*JHக(()ம்}|??:*(ம ெ#$ன்*Uமை)தாய்&*)சிNHGரி mnv**	தமிழ்வாக்கியங்கள்புத் தகம்மென்மைதாய்சிர ி

Tab. 3. Accuracy factor percentage based on learning rate and letter identification

Epoch	Iteration	Time taken (in ms)	Elimination factor	Proportional point (%)	Accuracy (%)
1	1	25	2.75	82	87
2	5	35	2.85	83	88
3	10	45	2.25	85	85
4	15	58	2.75	86	84
5	20	115	2.65	89	86
6	25	135	2.89	92	87
7	30	145	2.91	87	92
8	35	205	2.75	85	88
9	40	275	2.88	83	91
10	45	315	2.81	82	87

Tab. 4. Font based iteration and accuracy

Font Name	Iterations	Time taken (in ms)	Accuracy (%)
Bamini	10	35	84
	50	78	88
	100	110	86
Kural	10	25	84
	50	65	92
	100	95	87
Alangaram	10	55	88
	50	92	84
	100	115	85
Google Tamil	10	15	86
	50	30	92
	100	50	91
Latha	10	65	87
	50	105	88
	100	155	89
Myna	10	75	88
	50	118	89
	100	185	92

6. CONCLUSION

In this paper, set of images are taken and apply deep learning process to found Tamil Letters and test the results using different Tamil Font also. The images are pre-trained and removed unwanted data. Creates trained and test data set. Test data consist of 256 Tamil Letters and 6 fonts. Trained data are taken from image dataset and 512 × 512 × 3 layer deep belief network is generated. We tested the result both character wise and font wise. TensorFlow tool is used for experimental setup and 85% accuracy factor is obtained to recognized Tamil letter. In future, the font based character recognition and speech input may considered for recognition.

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