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Model for Decipherment of Braille Script and Speech Generation

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Abstract: The Braille system has been employed by the visually impaired for reading and writing. Due to limited availability and high cost of the Braille text books an efficient usage of the books becomes a necessity. With the introduction and popularization of text to speech converters, an enormous visit literacy rates are being seen amongst the visually impaired. Also, since Braille isn't well-known to the masses, communication by the visually impaired with the surface world becomes an arduous task. lots of research is being applied in conversion of English text to Braille but not many concentrates on the choice i.e. conversion of Braille to English. This paper proposes a technique to convert a scanned Braille document to text which might be read out too many through the Computer. The Braille documents are preprocessed to boost the dots and reduce the noise. The Braille cells are segmented and the dots from each cell are extracted and are mapped to the acceptable alphabets of the language. The decipherment of the Braille images requires image classification. There are basically two approaches to image classification which are supervised and unsupervised learning approach. We are implementing two supervised classification models to judge and compare accuracies, namely Support Vector Machine (SVM) and convolution Neural Network (CNN). At the end we use speech synthesizer to convert text into spoken speech.
Keywords: Machine Learning, Deep Learning, SVM, CNN, Braille System, Image Classification.

I. INTRODUCTION

Today, everything around us is digitalized. But there are about 285 million visually impaired people round the world who cannot cash in of digital information available on electronic gadgets during this digital-era. it's necessary to assist blind people by providing them with technologies and systems to permit them to interact and communicate among people and with one another without the vision problem. Braille is that the system which allows blind people to read and write using touch rather than vision. The Braille code was adapted by pedagogue within the early a part of the nineteenth century from a military system which used raised dots to send messages at nighttime. it's become the most system for the blind people. Braille uses the raised dots in groups of six which are arranged in three rows of two, and which are numbered from 1 to six. These six positions, which might be raised or flat, are employed in combination to offer just64 different Braille "characters. "This clearly means there can't be a one-to-one correspondence between Braille characters and text. within the simplest commonly used form, called Grade 1 Braille, the lowercase letters A-Z and the major punctuation symbols are represented by one Braille character, with "shift" characters getting used to point other information like upper-case letter, digits, and italics. For several reasons, including the dimensions of Braille characters (which are somewhat larger than normal text),the size and bulk of Braille documents (which need to be embossed on rather thick paper), and also the speed with which individuals can read information using touch , variety of nations have adopted a coding method, called Grade 2Brailleor contracted Braille. This further complicates the Grade 1code by introducing, in an exceedingly manner which is commonly specific to individual countries. As within the Braille system, characters are inscribed on paper using patterns of raised dots (embossing). So, they're more damage-prone. Also, their limited availability demands secure repositories. Most of the Braille documents available today are partially tampered, involve lots of noise or unclear. Hence a way called Optical Braille recognition; a sub branch of optical character recognition is employed. Optical Braille recognition can be termed as method of capturing and processing images of Braille characters into language characters. Its main use is to convert Braille documents. This vastly helps people who cannot read them in the form of text, and for preservation and reproduction of the documents in future. Many of the challenges to successfully processing Braille text arise from the character of Braille documents. Braille is mostly printed on solid-color paper, with no ink to supply contrast between the raised characters and the background paper. However, imperfections within the page can appear during a scan or image of the page. Many documents are printed inter-point, meaning they're double-sided. As such, the depressions of the Braille of 1 side appear inter-laid with the protruding Braille of the opposite side. Together with OBR (Optical Braille Classification), Speech Recognition would be more beneficial to the blind one. Our mission is to help visually impaired people by deciphering the available documents in Braille (Grade 1) and supply the audio files for those documents.

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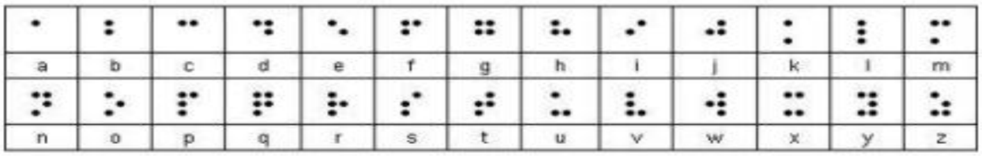
II. RELATED WORK

Braille, named after its creator Louis Braille, is the system used by visually impaired people to read and write. Traditionally written on embossed paper, each Braille character is represented as a rectangular block (called cell) with 6 dots. Each Braille cell includes six raised dots arranged in three rows, each row having two dots. Braille be the world's first binary encoding scheme for representing the characters of a writing system. English Braille predominantly has two levels of encoding:

1) *Grade 1:* Letter-by-letter transcription used for basic literacy



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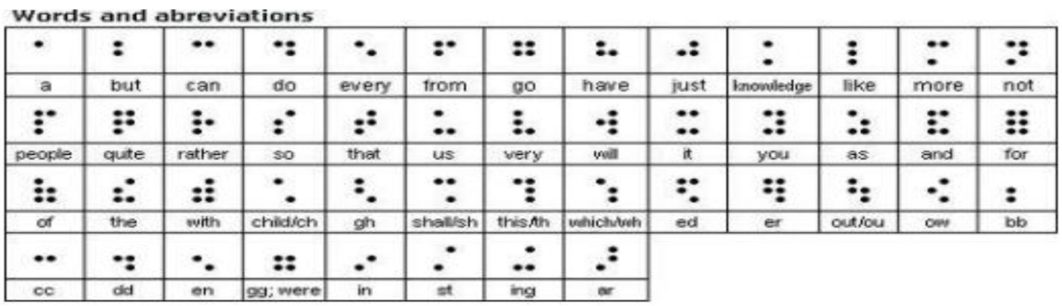
2) *Grade 2:* An addition of abbreviations and contractions



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The earliest work on computerized translation of Braille, reported in an exceedingly number of conferences, was primarily concerned with the interpretation from text into Braille so on assist within the automatic production of Braille books. Although some efforts are directed toward the issues of translating mathematical and musical texts the bulk of labor during this field has prohibited the automated translation of literary material into Braille. In 1984, a group of researchers at the Delft University of Technology designed a Braille reading tablet, within which a reading head with photosensitive cells was moved along set of rulers to capture Braille text line-by-line. In 1988, a gaggle of French researchers at the Lille University of Science and Technology developed an algorithm, called LectoBraille, which converted Braille documents into plain text. The system captured the Braille text with a low-resolution CCD camera, and used spatial filtering techniques, median filtering, erosion, and dilation to extract the Braille. The Braille characters were then converted to linguistic communication using adaptive recognition. The LectoBraille technique had a mistake rate of 1%, and took a mean time interval of seven seconds per line.[1] In 1993, a gaggle of researchers from the Katholieke University Leuven developed a system to acknowledge Braille that had been scanned with a commercially available scanner.[1] The system, however, was unable to handle deformities within the Braille grid, so it created a necessity to prepare a well-formed Braille documents.[3] In 1999, a bunch at the port Polytechnic University implemented an optical Braille recognition technique using edge detection to translate Braille into English or Chinese text.[4] In 2001, Murray and Dais created a handheld recognition system, that scanned small sections of a document without delay.[5] due to the tiny area scanned directly, grid deformation was less of a difficulty, and an easier, more efficient algorithm was employed.[3] In 2003, Morgavi and Morando designed a system to acknowledge Braille characters using artificial neural networks. this technique was noted for its ability to handle image degradation more successfully than other approaches.

This paper [4] uses Computer vision and pattern recognition techniques, to propose a way that converts a scanned Braille document to text, which might be read out. Braille cells are segmented so a Binary pattern vector for every Braille cell is generated. A vector features a length of 6 each correspond to a dot within the Braille cell. The presence of dot is identified after counting the quantity of white pixels in each grid of a cell and checking whether it satisfies the brink criterion. '1' indicates that dot is present and '0' indicates that dot is absent therein particular position. This string of bits for the sequence of Braille alphabets is converted to the alphabet using the tire structure also uses pattern recognition technique but with Kannada Braille script.

Paper [5] talks about a methodology where the image is initially pre-processed and then the obtained pre-processed image is segmented by converting it into binary after proper thresholding. Later support vector machine classifier is being used for classification of the Braille character to one of the English characters. But the limitation is noisy images. However, the use of standard Braille dimensions for Braille cells segmentation urges the document to be tilt-free. Also, the presence of noise/dots of size comparable to the size of Braille dots can't be removed and thus affects the overall accuracy.

III.METHODOLOGY

The System being designed uses CNN algorithm for braille character recognition and a user-friendly interface where the user can upload the braille document image and download the converted English text file and the corresponding audio file.

A. Data Collection

To train the proposed models, we collected around 1000 braille character images and more than 500 image URL links from various sources like GitHub and Kaggle. Later the features of each braille image were extracted into a excel sheet. The data is now available in excel format, but will need some pre-processing to be viable to train machine learning models. There are 732 attributes each depicting a pixel value and one label attribute, classifying the image into one of 27classes/labels[a-z].

B. Image Preprocessing

In order to simplify the method of Braille character extraction, the image is first segmented into lines and so into Braille cells. Each cell is further partitioned into binary dot patterns. These are achieved through Projection profiles and standard Braille measurements. Horizontal profiling is performed edge detected image and zero profile indicates the absence of dots. Similarly, vertical profiling is additionally performed. As a result of profiling the script is split into cells, where each cell represents a Braille character. Finally, these cells should be transformed into individual images, which act as input to the classifier.

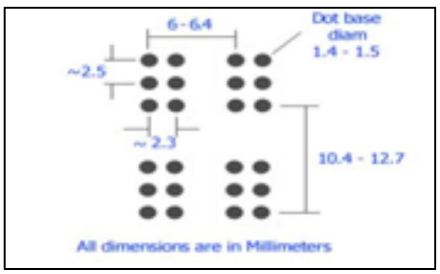

Fig.1 Braille character dimensions

C. CNN Image Classifier

Image classification refers to a process in computer vision that can classify an image according to its visual content. The classifier could be SVM or KNN or CNN etc. In the classifier, all layers' parameters are adjusted at the same time in a supervised learning method. By taking the output of the feature extractor as its input, the classifier is trained to make its output approach to a given target as close as possible.

The SVM image classifier is used for classification problems in Machine Learning. The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a hyperplane. SVM chooses the extreme points/vectors that help in creating the hyperplane. These extreme cases are called as support vectors, and hence algorithm is termed as Support Vector Machine.

The convolutional neural network (CNN) is a class of deep learning neural networks. A CNN **convolves** learned features with input data and uses 2D convolutional layers. This means that this type of network is ideal for processing 2D images. Compared to other image classification algorithms, CNNs use very little preprocessing. This means that they can **learn** the filters that have to be hand-made in other algorithms.

1) CNNs have an input layer, and output layer, and hidden layers. The hidden layers usually consist of convolutional layers, ReLU layers, pooling layers, and fully connected layers.
2) Convolutional layers apply a convolution operation to the input. This passes the information on to the next layer.
3) Pooling combines the outputs of clusters of neurons into a single neuron in the next layer.
4) Fully connected layers connect every neuron in one layer to every neuron in the next layer

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D. CNN Model Algorithm

1) The dataset is loaded and segregated into training and testing sets (Each row in the dataset represents an image).
2) Each image is convolved using a series of layers as shown in fig.2.
3) Finally it's classified into one of the 27 labels.

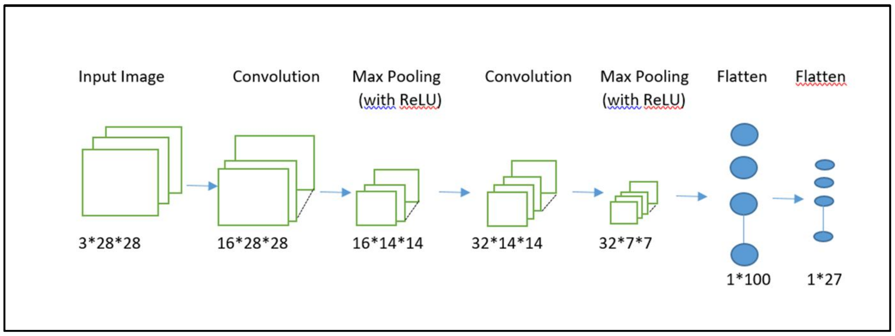


Fig.2 CNN Training Model

E. General Steps used in System

1) The given Image (braille document) is pre-processed to enhance it.
2) Image is horizontally segmented into lines.
3) Each horizontal segment is vertically segmented into individual characters.
4) Individual character images are passed to the trained model and classified as one of the 26 alphabets or a whitespace.
5) Each alphabet is written into a file
6) The file is improvised using built-in library
7) Convert the text file to audio file

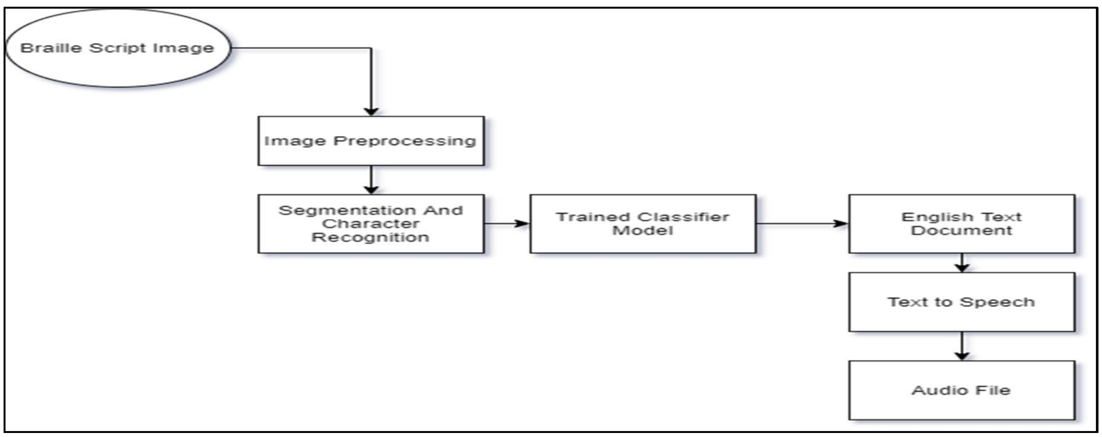


Fig.3 System design

F. Hardware Requirement

1) *Processor:* Quad core Intel Core i7 Skylake or higher (Dual core is manageable).
2) *RAM:* 6GB of RAM or higher.
3) *Storage:* Minimum 500 MB HDD (SDD is preferable for better performance).
4) *GPU:* Nvidia 9x or 10x series (preferable to use graphic card that supports CUDA toolkit).

G. Software Requirement

1) *Operating System:* Windows / Linux / MacOS
2) *Python 3+:* Programming language
3) *NumPy 1.18.2:* NumPy is the fundamental package for scientific computing with python
4) *gTTS:* This is required for text to audio conversion

IV. RESULTS AND ANALYSIS

This paper focuses on decreasing the complications faced by both visually impaired people and sighted people while reading a Braille Document by generating corresponding audio files.

We created a dataset with over 1500 Braille images and URLs spanning 26 English Braille alphabets from various sources over Internet. Initially, English Braille to English language Translator Model was trained with the Convolution Neural Network (CNN) and Support Vector Machine (SVM) classifiers to compare accuracy and performance metrics. An accuracy of 95.83% was achieved with CNN model while SVM model gave 83.47% accuracy. So, CNN classifier was chosen.

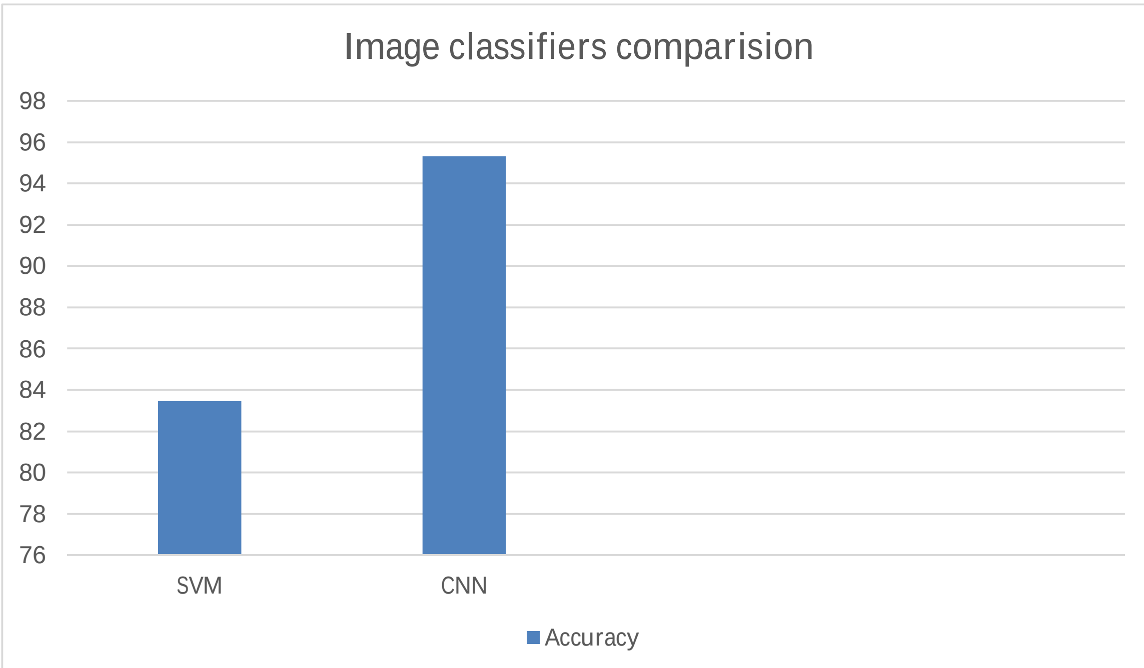


Fig.4 Image Classifiers comparison

The neural network model was trained to an accuracy of 95.83%. The model was able to decipher low definition English Braille documents into plain English text in the testing phase and gave satisfactory results. These English documents obtained are used to generate audio files with the help of APIs.

Our model has gained higher validation accuracy than few of the existing systems [1], [2], [3]

```
Epoch: 16
Training Loss: 2.6563
Validation Loss: 1.1687
Accuracy on the test set: 56.2500%
Epoch: 17
Training Loss: 2.1774
Validation Loss: 0.5015
Accuracy on the test set: 81.2500%
Epoch: 18
Training Loss: 1.6044
Validation Loss: 0.3086
Accuracy on the test set: 91.6667%
Epoch: 19
Training Loss: 1.0945
Validation Loss: 0.1661
Accuracy on the test set: 95.8333%
Epoch: 20
Training Loss: 0.7405
Validation Loss: 0.3702
Accuracy on the test set: 95.8333%

time: 5.211771011352539 s
```

Fig.5 Training epochs

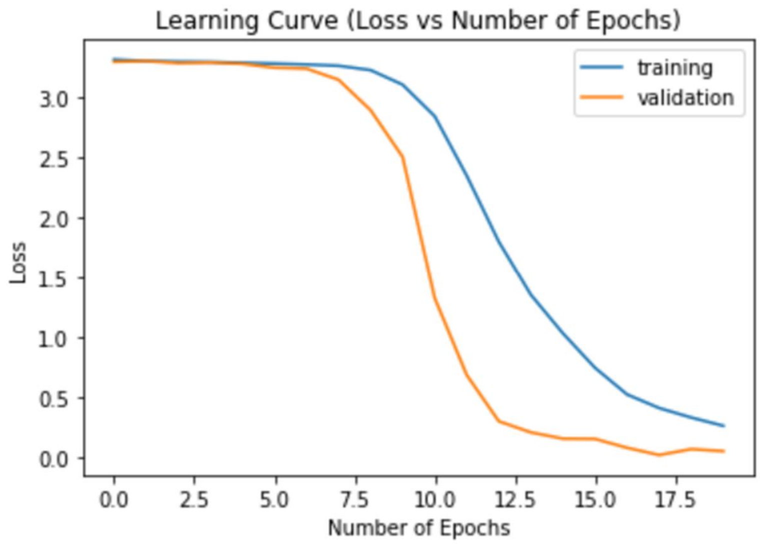


Fig.6 Final Testing Result

V. CONCLUSION

Image Classification has gained wide range of popularity in the world. It's being extensively used in various domains and applications. Braille Classification is one of the applications which provides visually impaired people a great advantage. It also caters to other people who are willing to learn the braille. We through this paper has built an efficient method to classify braille into speech eliminating the traditional time-consuming process which involves recognizing the patterns by touch. To provide product which any user could leverage, we have combined our model into a web application where it dynamically read the braille document and gives the voice output.

VI.FUTURE WORK

In the future the CNN model can be further improvised with different layer combinations and larger dataset for better training. The system can be enhanced to give reliable results even for rotated and tilted documents
Further it can be extended for grade 2 braille with punctuations.

REFERENCES

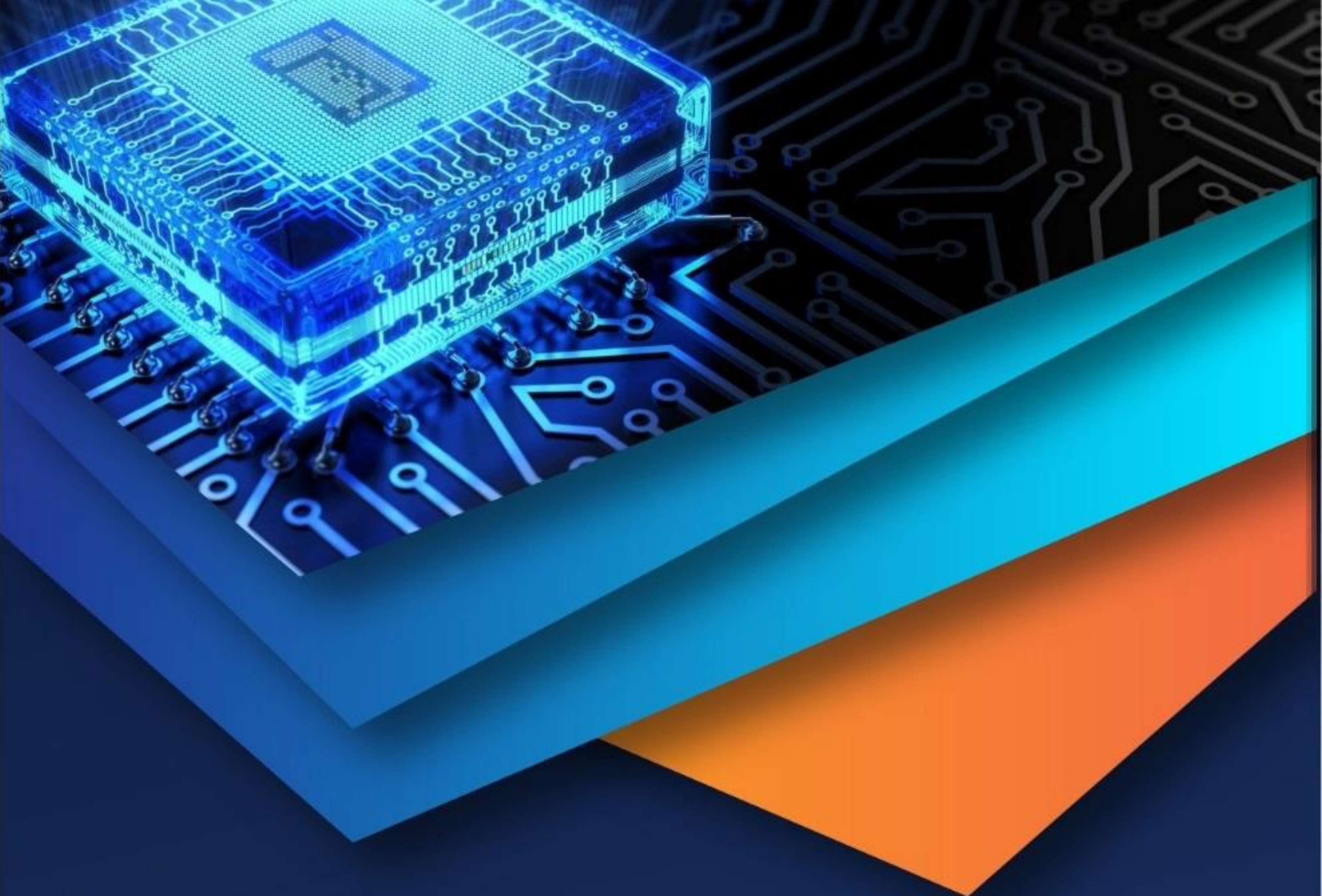
[1] Blenkhorn, P. (1995). A system for converting Braille into print. IEEE Transactions on Rehabilitation Engineering, 3(2), 215–221. doi:10.1109/86.392366

[2] International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 5, Issue 4, April 2016

[3] Ng, C. M., Ng, V., & Lau, Y. (n.d.). Regular feature extraction for recognition of Braille. Proceedings Third International Conference on Computational Intelligence and Multimedia Applications. ICCIMA'99 (Cat. No.PR00300). doi:10.1109/iccima.1999.798547

[4] Padmavathi, S., K.S.S, M., Reddy .S, S., & D, M. (2013). Conversion of Braille to Text in English, Hindi and Tamil Languages. International Journal of Computer Science, Engineering and Applications, 3(3), 19–32. doi:10.5121/ijcsea.2013.3303

[5] Rupanagudi, S. R., Huddar, S., Bhat, V. G., Patil, S. S., & Bhaskar M. K. (2014). Novel methodology for Kannada Braille to speech translation using image processing on FPGA. 2014 International Conference on Advances in Electrical Engineering (ICAEE). doi:10.1109/icaee.2014.6838445



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