

Comparison Of Machine Learning Techniques for Hand Written Digit Recognition

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Abstract – Recognition of handwritten digits has been very popular currently. Many researchers are quite keen in handwritten digit recognition. Due to the transformation of many machine learning, deep learning, and computer vision algorithms, we are using algorithms such as SVM, KNN, RFC, and CNN to bring out the different accuracies with the contrast of each algorithm. Deep learning algorithm like multilayer CNN uses Keras with Theano and Tensor Flow.

Key Words: CNN, KNN, RFC, SVM

1. INTRODUCTION

Handwritten digit recognition's main purpose is to identify the physically written digit from a wide assembly of sources may be from messages, papers, pictures, etc. This has been a subject of research for a colossal timeframe. Few research areas involve signature validation, bank cheque refining, postal address comprehension, etc...

Many more algorithmic strategies for handwritten digit recognition have been developed using Machine Learning, techniques like K-Nearest Neighbours, SVM Classifier, Random Forest Classifier, etc...

These approaches have an efficiency of 97% but it is not well efficient for real-world applications one event for illustration of the real world scenario that is assumed if we a post a letter with a beneficiary name as "Anuj" and the computer (The algorithm) identifies it as "Tanuj" by then the letter would be given to "Tanuj". In spite of this name change, the letter may come to the right location, but this technical mistake may cost a load. Hence these efficiency is demanding and crucial and previous techniques did not implement this crucial requirement due to less knowledge about the function to be performed.

Here come the usage and adoption of Deep Learning. In the spent years ago, Deep Learning has become the blazing subject in image processing. A load of machine learning appliances has been advanced for object detection, digit recognition, and character identification the precision in these applications is vital yet these machine learning algorithms were not able to provide the exact correctness in the identification and hence the usage of Deep Learning

is adapted. A huge amount of AI contraptions have been made like sci-kit learn, scipy , etc Keras, Theano, Tensor Flow by Google, TFLearn , etc for Deep Learning. These contraptions make the applications liberal along these lines distinctly. The Artificial Neural Networks can in each viable sense reflect human cerebrum. Example, Convolutional Neural Networks with Back Propagation for Image Processing.

2. LITERATURE SURVEY

[1] Bangla text document categorization mistreatment random Gradient Descent (SGD) classifier

This paper portrays the Bangla Document Categorization using sporadic Gradient Descent (SGD) classifier. Here account procedures that the errand inside which content reports are referenced into one or a lot of predefined classes kept up their substance. The foreseen framework will be passed on into 3 stages: one. Highlight extraction joining term go over and talk record emphasizes (IDF), 2. Classifier style abuse the sporadic Gradient Descent(SGD)algorithmic by learning the particular choices, and 3. execution. Inside theon BDNews24 records, it's found that our for eseen soundness gives higher exactness considered the procedures kept up Support Vector Machine (SVM) and Naive Bayesian (NB) classifier.

[2] Best Practices for Convolutional Neural Networks Applied to Visual Document Analysis

Neural structures are a strong movement for requesting of visual information sources climbing out of records . Regardless, there's jumbling pointlessness of various neural framework procedures that are utilized in the course of action and thus. This paper plots a gathering of strong grasped strategies that archive examination supervisors will use to start sensible results with neural frameworks. The essential key watch is getting planning set as best as would be reasonable: we will when all is said in doneen large the orchestrating set by trading it up of turned learning. The subsequent most fundamental watch is that convolution neural frameworks are higher fitted to visual record assignments than totally related structures .We will everything considered recommend that an undeniable "do-it-with no other individual's

assistance" use of convolution with versatile arrangements reasonable for a few visual report issues. The this fundamental convolution neural network framework doesn't require caught systems, like control, weight ruin, structure subordinate learning rates, averaging layers, straying prop, or possibly finely-tuning the ame-plan. The top result's an amazingly clear not withstanding wide game-plan which may yield dynamic execution for report examination. We will all around location our cases on the MNIST set of English digit pictures.

[3] At liberty written neural recognition mistreatment majority balloting classifier. In Parallel Distributed and Grid Computing

Unconstrained withdrew shaped attestation might be troublesome downside .it's shockingly difficult to seek out high attestation results utilizing a solitary classifier. This paper demonstrates an indisputable profile, joined close-by & far-reaching choices and bigger part balloting classifier for at circumstance made numeral attestation. the edirect profile includes figured by abuse the left, right, the prime and base profile of an image. A segment vector of length 112 is made by consolidating the majority of-of the profiles. The close-by segment vector is confined by applying Daubechies moving edge adjust on the four pictures that were gotten by applying the schnapps supervisor, and as requirements be the comprehensive decisions that are acquired by applying the vague Daubechies moving edge update on the shrouded picture. A section vector of length eighty is made by joining the sixty four neighborhood and sixteen comprehensive choices. The par vectors are the force of a pel inside the third estimation check segment of an image. amidst this starter four neural system classifiers: multilayer feed forward, Pattern insistence Cascade forward, perform fitting neural structure classifiers 2relatedmath classifiers: inear discriminant examination and KNN classifiers are utilized for depicting these alternatives. An overall part balloting subject has been performed with 3 neural structure classifier and KNN classifier. The execution endeavors on MNIST dataset. The structure was set upon sixty,000andendeavored on ten,000 numeral cases of that ninety eight.05% investigate tests are genuinely observed.

[4] Increased root extraction and document classification algorithmic rule for Arabic text

Diverse substance extraction and get-together structures are made for English and elective in general tongues; by a wide edge by far, most of the vernaculars are kept up roman print. Regardless, Semitic is one among the exceptional dialects that have to emerge models and morphology .Not a few systems are made for Arabic

substance strategy. Semitic is one among the Semitic tongues with morphology that is the colossal proportion of troublesome than English. By uprightness of its mangled morphology, there's essential for pre-organizing timetables to oust the establishments of the words by then delineate them as per the stack of acts or which translates. in the midst of this theory, a structure has been made and tried substance delineation. the structure relies on 2 designs, the key is to remove the roots from substance and hence the second is to depict the substance as per predefined classes the semantic root extraction sort out contains 2 standard stages. the central part is to supervise clearing of joins in like manner as prefixes, postfixes and infixes . Prefixes and postfixes are cleared looking on the length of the word, while checking its morphological model once every acknowledgment to discard infixes . inside the second part , there as on extraction algorithmic standard is made to regulate fragile ,delineated, shed long-vowel and two-letter geminated words , as there's a massive wide degree of sporadic Arabic words in works. Precisely when the roots are removed, they're checked against a predefined once-over of 3800 trilateral and 900 quad mentioning roots .The approach of essentials has been made to lift and research execution of the anticipated algorithmic standard . The obtained results found that the made estimation has higher accuracy than the powerful algorithmic program. The second stage is that there port course of action ort out. In the midst of this stage 2 estimation classifiers are attempted, particularly rtificial neural networks (ANN) and Support Vector Machine (SVM). he structure is setup on big orders: culture, economy, around the globe, neighborhood, sureness, and sports. The system is set up on eightieth of the accessible data. From each class, the ten prime solid terms are picked as decisions. Testing the portrayal estimation shave been done on the remaining twentieth of the records. The conceivable after effects of ANN and SVM meandered from the quality strategy used for substance delineation, the terms repeat based rationality. Results exhibit that ANN and SVM have higher precision (80-90%) rose up out of the quality methodology (60-70%). The foreseen framework shows the flexibility to sort the Arabic substance reports into the agreeable classes with a high exactitude rate.

[5] MNIST Handwritten Digits

Each reasonable work needs two or three estimations. To consider the execution and exactness of penmanship at testation which top tier, the MNIST dataset is a generally bewildering dataset holds 60,000 models for preparing and 10,000 test tests. In this report, we give a delineation on MNIST dataset and present some MATLAB codes for investigating the IDX record gathering, which MNIST tests are verified in this chronicle position.

[6] Unconstrained handwritten numeral recognition using majority voting classifier

Unconstrained isolated physically formed numeral certification is a troublesome issue. It is hard to discover high insistence results utilizing a solitary classifier. This paper introduces basic profile, joined adjoining and generally speaking highlights and overpowering part tossing a vote plot classifier for the unconstrained interpreted numeral assertion. The fundamental profile fuse is enrolled by utilizing the left, right, the top and base profile of a picture. Apart vector of length 112 is kept by joining the majority of the profiles. The territory vector is cleared by applying Daubechies wavelet on the four pictures that were obtained by applying the Kirsch manager, and the general highlights that are gotten by applying the corresponding Daubechies wavelet on the foremost picture. A sociation vector of length 80 is shaped by consolidating the 64 close-by and 16 by and large highlights. The segment vectors are the intensity of a pixel in the third estimation induce segment of a picture. In this examination four neural system classifiers: Multilayer feed forward, attorn confirmation, Cascade forward, unction fitting neural structure classifiers and two honest classifiers: Linear discriminant examination and KNN classifiers are utilized for mentioning these highlights. A bigger part tossing a count plot has been performed with three neural system classifier and KNN classifier. The execution endeavors on MNIST dataset. The structure was set upon 60,000 and endeavored on 10,000 numeral ses of which 98.05% test tests are definitely observed.

3. EXISTING SYSTEM

A ton of plan structures utilizing Machine Learning have been and utilized for this like-Nearest Neighbors, classifier, Random Forest Classifier, and soon, at any rate, these strategies for knowledge paying little notice to the way that having the exactness of 97% are absent for these present reality applications. One occasion of this is, on the off chance that you post a letter with recipient name as "Anuj" and the structure sees and reviews that it as "Tanuj" by then it won't be passed on to "Anuj" yet "Tanuj". At any rate finally, it might go to the correct district yet on the off chance that the mail is central, this suspension can cost a ton. Along these lines, the precision in this applications is astoundingly basic yet structures don't give the required exactness in light of close to no finding a couple of arrangements concerning the topology of an errand.

4. PROPOSED SYSTEM

The proposed structure joins database appearing and preprocessing and gathering utilizing AI checks like SVM

classifier, nd (K-Nearest Neighbors), RFC (Random forest classifier) and colossal learning estimation CNN (convolution neural system).

The MNIST is an information dataset, a subset of a massive set NIST, is a database of 70,000 handwritten digits, divided into 60,000 training examples and 10,000 testing samples. The images in the MNIST dataset are existent in the form of an array consisting of 28x28 values depicting an image as well as its labels. Analysis Ter data and Classification Based on the algorithm classified

4.1 Random Forest Classifier (RFC)

Random Forest Classifier Is an ensemble method adopted for classification or regression. random Forest Classifier works using a massive collection of decor related decision trees. In this, the training data form a matrix as input. Using this matrix, a large number of a new matrix with random elements is established. Using each of this matrix, an analogous decision tree is formed for classification of the testing data. When the testing data is input, all these decision trees segregate the input test data and predict the class to which the input belongs. The result is formed based the prediction result as the maximum count as the result of the classifiers. To make predictions, once the training is done, the average of predictions from all individual

4.2 K-Nearest Neighbors (KNN)

K-Nearest Neighbors is an algorithm in which the best estimate among all the values is the value that has a maximal number of neighbors with the smallest Euclidian or Hamming distance. KNN is instance-based learning. To work well, this algorithm requires a training dataset which is a set of well-labeled data points. This algorithm takes as input a new data point and makes the classification for this by measure the Euclidian or Hamming distance among the new data point and the labeled data

4.3 SVM Classifier

In machine learning, support vector machine is a crucial model. It is a supervised learning model used for classification and regression. In this model, we are given a set of training in which each one of them is marked to be belonging to one of the two categories. support Vector Machine model represents a point in space is mapped such that the two different classes with their elements are separated by as much distance as possible. The image pixels or the input under test is mapped into this space and predictions are made based on the class or category to which the test input belongs. The graphical representation of working of an SVM

5. METHODOLOGY

How we are Retrieve MNIT

- Investigate the MNIST dataset records utilizing python as "RB".
- For reach record, there is a particular interest number. Take the information records one by one and read them the condition for the magic number is a fulfilled for example if the interest number matches the kind of the report. or instance, to look at the raining Set Image information report, you have to check first if the interest numbers indistinguishable to 2051 else don't take a gander at the record for marks.
- Explore the extent of lines and parts gave in the information record the next segment to the interest number.
- Utilizing this data, read the 28x28 information relating to the particular scratching gave in the line sharp gameplay.
- Scan for after the above strides for rest of the records and put the particular information in the factors. The most remote point that takes a gander at the picture information restores the picture data and the names.

5 .SYSTEM DESIGN

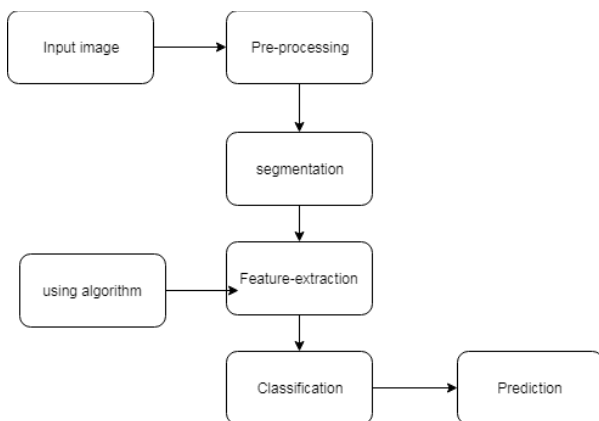


Fig -1: System design

System design is the means of illustrating the architecture, components, modules, interfaces, and data for a system to appease stated requirements. One could see it as the employment of systems theory to product development. There is some overlap with the disciplines of systems analysis, systems architecture and systems engineering. If the broader topic of product development "blends the perspective of marketing, design, and manufacturing into a single approach to product development," then design is the act of taking the marketing information and forging

the design of the product to be assembled. Systems design is accordingly the process of defining and developing systems to satisfy specified requirements of the user.

6. IMPLEMENTATION

To demonstrate the working precision of Machine Learning checks, Here utilizing three classifiers as looks for after:

- Random Forest Classifier [RFC]
- K-Nearest Neighbors [KNN]
- Support Vector Machine [SVM]

7. APPLICATION

- Bank check dealing with
- Extracting business card data in contact list
- Data portion for business archives like visa, receipt, bank illumination and receipt.
- Automatic protection records key data extraction.
- Number plate confirmation.

8. RESULTS

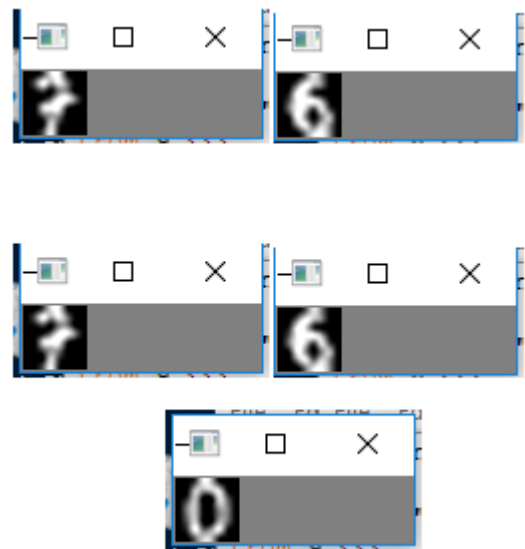


Fig -2: Digit Recognition


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training data points: 1212
validation data points: 135
testing data points: 450
EVALUATION ON TESTING DATA
      precision    recall  f1-score   support

0         1.00      1.00      1.00        43
1         0.95      1.00      0.97        37
2         1.00      1.00      1.00        38
3         0.98      0.98      0.98        46
4         0.98      0.98      0.98        55
5         0.98      1.00      0.99        59
6         1.00      1.00      1.00        45
7         1.00      0.98      0.99        41
8         0.97      0.95      0.96        38
9         0.96      0.94      0.95        48

 micro avg       0.98      0.98      0.98       450
 macro avg       0.98      0.98      0.98       450
 weighted avg    0.98      0.98      0.98       450

Digit is: 7
Digit is: 6
Digit is: 7
Digit is: 6
Digit is: 0
    
```

Fig -3: Accuracy Score

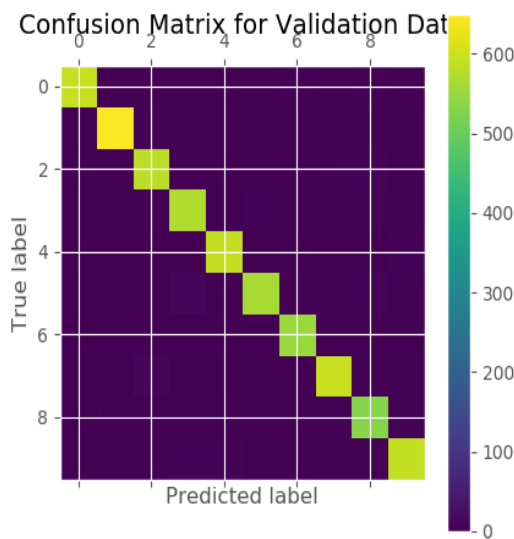


Fig -4: Confusion Matrix

| Layer (type) | Output Shape | Param # |
|-------------------------------|--------------------|---------|
| conv2d_1 (Conv2D) | (None, 24, 24, 16) | 1216 |
| max_pooling2d_1 (MaxPooling2) | (None, 12, 12, 16) | 0 |
| conv2d_2 (Conv2D) | (None, 8, 8, 32) | 12832 |
| max_pooling2d_2 (MaxPooling2) | (None, 4, 4, 32) | 0 |
| flatten_1 (Flatten) | (None, 512) | 0 |
| dense_1 (Dense) | (None, 1000) | 513000 |
| dense_2 (Dense) | (None, 10) | 10010 |

Total params: 537,058
Trainable params: 537,058
Non-trainable params: 0

Digit is a 8 with 100.0% accuracy.

Fig -5: Convolutional Neural Network

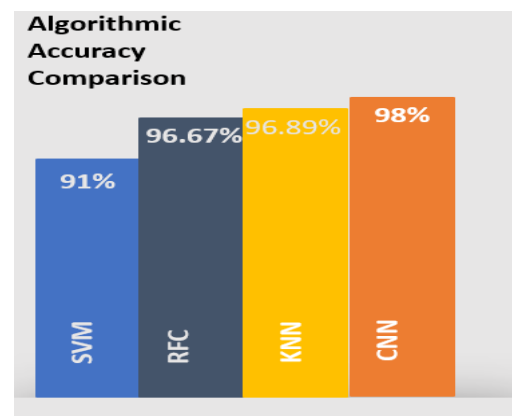


Fig -5: Accuracy Comparison

8. CONCLUSION

An implementation of Handwritten Digit Recognition using Deep Learning has been implemented in this paper. Additionally, some of the most widely used Machine Learning algorithms i.e. RFC, KNN and SVM have been trained and tested on the same data to draw a comparison as to why deep learning methods is required in critical applications like Handwritten Digit Recognition. This paper shows that that using Deep Learning techniques, a very high amount of accuracy can be achieved. Using the Convolutional Neural Network with Keras and Theano as backend, to get an accuracy of 98.72%. In addition to this, implementation of CNN using TensorFlow gives an even better result of 99.70%.

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