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| Sr. No | Title of the paper | Name of the Author | Published Year | Remarks |
| 1. | Handwritten Digit Recognition Using Machine Learning | Rabia  Karakaya,  Serap Kazan. | 2021 | * ALGORITHMS:   Support Vector Machine(SVM),Decision Trees, Random Forest, Artificial Neural Networks, k-Nearest Neighbor, K-Means Algorithm   * APPLICATIONS:   Reading, archiving old documents, bank cheques, and letters   * DATA SET: Modified National Institute of Standards and Technology (MNIST) * The MNIST database contains 60k training data and 10k test data.   \*SVM and ANN compared to the obtained accuracy rates  \*Handwriting recognition has some general steps. are: pre-processing, segmentation, feature extraction, classification and recognition, post-processing  A Python library called Scikit Learn  was used in the study. It offers the  opportunity to effectively implement many  machine learning algorithms. It enables the rapid  training and testing of machine learning  algorithms with high level languages.   * SVM: * ADVANTAGES OF SVM: * SVM is successful in solving classification problems * Kernel function selection is an important step in the process of svm to solve a problem * In this SVM method the highest accuracy was obtained * work strongly and efficiently in situations where educational data are small * DECISION TREE: * ADVANTAGES OF DECISION TREE: * The tree structure and rules are easy to understand * Decision trees method consists of simple sequential decision making operations * Decision trees make inferences from the existing data set and form the tree structure * Random Forest: * Advantages of Random Forest: * Random forest algorithm can be used in both classification and regression problems like decision trees. * The logic of work is to create more than one decision tree and produce average results with the help of trees. * Artificial Neural Network: * Advantages of ANN: * ANN model is modeled on the transmission of human nervous system and parallel computing ability of human brain instead of computer architecture. * Output’s are created for each character’s matrix. * Disadvantages of ANN: * Hidden layers causes the training process to take too much time * In this algorithm the Relu was introduced. * KNN * In this method, first of all, the similarity of the test data to be classified with the education data is calculated. Classification is made according to the threshold value determined with the average of the k data that appears to be the closest. The performance of the method is influenced by the closest neighbor number, threshold value, similarity measurement and sufficient number of normal behaviors in the learning cluster. * Although it has a simple structure, it worked fast and gave high-accuracy results. * DATA SET:MNIST * K-MEANS ALGORITHM: * the only algorithm that is an unsupervised learning algorithm is the K-means algorithm * It provided a very high efficiency in * the tests and made very little mistakes in   clustering. |
| 2. | **Handwritten Digit Recognition System** | Shubham Mendapara, Krish Pabani,  Yash Paneliya | 14-OCTOBER -2021 | * **ALGORITHMS:**   Artificial Neural Networks (ANN),Deep Learning,  Convolution Neural Network   * **APPLICATIONS:**   (OCR) is a part of image processing that leads to excerpting text from images. Recognizing handwritten digits is part of OCR.   * **DATA SET:**   MNIST Data Set   * **ACCURACY:**   By Using CNN the accuracy is 98.85%   * **KEY WORDS :** Handwritten digit recognition, Convolution Neural Networks (CNN), MNIST dataset, TensorFlow, Keras, OpenCV, Deep Learning. * **ANN:**   Artificial neural networks (i.e., ANN) which is considered to be the best for the purpose. Artificial neural networks are similar to the neural network of the human brain which is a set of I/O units that are linked together (i.e., neurons) where each connection has a weight associated with it, and each relation has a weight associated with it.   * ANN to build statistical models from massive datasets * It has three layers-input layer,hidden layer,output layer. * CNN:   CNN plays a very crucial role in many image processing applications. CNN is used for detection of data loss (fault) and accuracy of the application.   * CNN using TensorFlow, Keras, OpenCV. * Many researchers are using this technique other than machine learning algorithms such as SVM, KNN, and RFC etc., they prefer to use CNN because it gives high accuracy in image classification, video analysis etc. * MODEL ARCHITECTURE * Convolutional Neural Network is a special type of multi-layered neural network which is modeled to identify visual patterns from pixel images with nominal preprocessing. The basic CNN includes four components, like the convolution layer, the pooling layer, the flatten layer, the output layer and the image is passed through all these layers. The image at the end reaches the output layer. Pooling layer is optional depending on the image type whether is required or not. CNN is formed by various layers of neurons that transfer input parameters to the output. To choose which neuron to activate in each layer there is an activation function such as ReLU, Sigmoid, SoftMax etc. ReLU is a widely used activation function. After the dataset is loaded, we separated data into two parts X and Y in the following way. As we know the original file contained 60,000 images representing different digits. For training (x) and testing(y) we will split the dataset into 9:1 ratio. So, we split it into two parts of 54000 and 6000 images. * **CONCLUSION:**   The Handwritten Digit Recognition using Deep learning methods has been implemented.    The most widely used Machine learning algorithms CNN has been trained and tested on the MNIST dataset. |
| 3. | Handwritten Digit Recognition using Machine and Deep Learning Algorithms | Ritik Dixit  Rishika Kushwah  Samay Pashine | 23-JUNE-2021 | * **ALGORITHMS:**   Support Vector Machines (SVM),  Multi-Layer Perceptron (MLP) and Convolution Neural Network (CNN) models.   * **SOURCES:**   human handwritten digits from different sources like images, papers, touch screens, etc.   * **APPLICATIONS:**   Number plate recognition, Postal mail sorting, Bank check processing, etc.   * This paper provides a reasonable understanding of machine learning and deep learning algorithms like SVM, CNN, and MLP for handwritten digit recognition. * With the humanization of machines, there has been a substantial amount of research and development work that has given a surge to deep learning and machine learning along with artificial intelligence. * **DATA SET:**   **MNIST DATA SET**   * **SUPPORT VECTOR MACHINE:** * Support Vector Machine (SVM) is a supervised machine learning algorithm * In this, plot data items in n-dimensional space where n is the number of features * SVM chooses the extreme vectors that help in creating the hyperplane,Hence these are called as Support vectors. * Two types of SVM:   1.LINEAR  2.NON-LINEAR   * **MULTI-LAYERED PERCEPTRON:** * A multilayer perceptron (MLP) is a class of feedforward artificial neural networks (ANN). * It consists of three layers: input layer, hidden layer and   output layer.   * Each layer consists of several nodes that are also formally * referred to as neurons and each node is interconnected to every other node   of the next layer.   * Each layer consists of several nodes that are also formally   referred to as neurons and each node is interconnected to every other node of the next layer.   * Every hidden layer of the model can have different   activation functions for processing. For learning purposes, it uses a supervised  learning technique called backpropagation.  **CONVOLUTIONAL NEURAL NETWORK:**   * CNN is a deep learning algorithm that is widely used for image recognition and classification. It is a class of deep neural networks that require minimum pre-processing. * CNN contains 3 layers namely, an input layer, an output layer, and multiple hidden layers which include Convolutional layers, Pooling layers(Max and Average pooling), Fully connected layers (FC), and normalization layers. * **IMPLEMENTATION:**   To compare the algorithms based on working accuracy, execution time, complexity, and the number of epochs (in deep learning algorithms) we have used three different classifiers:  • Support Vector Machine Classifier  • ANN - Multilayer Perceptron Classifier  • Convolutional Neural Network Classifier  **PRE-PROCESSING**  Pre-processing is an initial step in the machine and deep learning which focuses on improving the input data by reducing unwanted impurities and redundancy. |
| 4. | **Hand Written Digit Recognition using Machine Learning** | Rohan Sethi ,  Ila Kaushik. | 23-june-2020 | **AIM:** The main aim of this paper is to demonstrate and represent the work which is related to hand-written digit recognition.  **APPLICATIONS:** Number Plate Recognition, education, finance and other fields.  **ALGORITHMS:**   * **Naïve Bayes Classifier:**   The classification  algorithm which is mathematically based on  Bayes’ Theorem and assumes the independence of  predictors is known Naïve Bayes Classifier.   * These properties contribute to the probability   independently.   * It is useful for large datasets as it is   not very much difficult to build.   * **Nearest Neighbour:** * The K-Nearest Neighbour   supervised machine learning algorithm can be defined as algorithm in which labelled dataset is  taken as the input and the computation as desired  for the output, is held over. The feature space  contains the K-Nearest Neighbour training  examples. Also, it is an instance-based learning.   * **LOGISTIC REGRESSION:** * The main motive of this algorithm is to search for a perfect fitting model which depicts the relationship among the dichotomous variables and independent variables * **Decision Trees:** * The classification algorithm which builds the regression and classification models in the form of a structure of a tree. * The topmost   decision node of the tree is known as the root node,  which is the best predictor node of the decision  tree. It could handle numerical as well as  categorical data.   * **Random Forest:** * The construction of multitude decision trees at the training time which actually formulates the decision trees for the combinational learning methods for regression and classification. They tend to overfit their training dataset for correct decision trees * **Neural Network**: * The neural network classification algorithm in supervised machine learning contains the units of neural network better known as neurons which are known to convert the input vector into considerable output and structurally organized in layers. * ***DISADVANTAGE***: * This technique is that it does not support feedback system for every neuron involved in the network. * KNN-Based Architecture: * K-Nearest Neighbors Algorithm, can be defined as the supervised machine learning algorithm. * which is nonparametric in nature and applied in the areas of classification and regression. * KNN-also known by the term Lazy learning or late learning. * **APPLICATIONS OF KNN ALGORITHM:**   Euclidean distance, Manhattan distance, Minkowski function, Hamming function and Mahalanobis function.   * **STEPS FOR KNN-ALGORITHM:**   1.Computation of distance metric between testing data points and all the labelled data points.  2. The data points which are labelled are enjoined in the ascending order of distance metric.  3.Selection of the top K labelled data points.  4.The class labels are matched with the K labelled data points and assigned to the test data points.  **DATA SET:**MNIST DATA SET  **The approach to find a solution to the problem of handwritten numeral recognition is broadly classified into three blocks**:   1. Pre‐Processing 2. Feature Extraction using PCA 3. Classification using 1‐Nearest Neighbour algorithm;  * **CONCLUSION:** * The work deals with hand-written digit classification, using the efficient KNN supervised machine learning algorithm. |
| 5. | **Handwritten Digit Recognition Using CNN** | Mayank Jain,  Gagandeep Kaur,  Muhammad Parvez Quamar | 2021 | * Handwritten digit recognition can be performed using the Convolutional neural network from Machine Learning. * DATA SET:MNIST DAT SET   Our digit dataset contains about 70,000 images of digits 0-9.  This is further divided into two parts i.e., Training set data  and Testing set data.[4] The training dataset contains about  60,000 handwritten digits and the test dataset contains about  10,000 handwritten digits.   * **STEPS :**  1. Pre-processing the dataset. We will change some parameters 2. Next step will be to build the model that will   help us in prediction. Here comes the part of CNN   1. The model is based on CNN and all the layers of CNN. 2. After   building the model it’s time for training and testing the model and also check the accuracy   * such as colour of the images, size of the images to ease our * processing. * IMAGE REPRESENTATION:28\*28 * **DIGITAL IDENTIFICATION MODULE**  1. **Pre-Processing:**   pre-processing steps such as importing the images, changing the size of the images, changing the colour of the images, visualizing the image dataset and converting them from categorical to vector form.   * We are converting our image from RGB to Gray scale for easy computation by dividing with 255-pixel value to get the value between 0-1. * In this process we are also converting the data from categorical value to vector form or binary form.  1. **Principle of Convolutional neural network:**  * After preprocessing step,we have to create CNN model. * The layers of CNN are   (a) Convolutional Layer  (b) ReLu Layer  (c) Pooling Layer  (d) Fully Connected Layer   * Convolutional Layer: Convolutional layer is a simple application of a filter which acts as an activation function.What this does is takes a feature from a input image, then filter different features from that image and makes a feature map. Some of the features are location, strength etc. the filter is then moved over the whole image and the value of each pixel is calculated. * RELU LAYER: used to remove negative pixel values from the image and replace them with zero. * POOLING LAYER: The main function of this layer is to shrink the image size. This is done to ease the computation speed and also decrease the computational cost. * FULLY CONNECTED LAYER: This is the last layer of CNN. This is the part where * the actual classification happens. All the matrix * from the pooling layer is stacked up here and put * into a single list. The values which are higher are * the points of prediction for the given image. * Sequential is used to keep all the processes in a sequence one after another. * The code Dropout is used to dropout values from the dataset to reduces the over fitting. * ACCURACY: CNN design with three layers conveyed better   acknowledgment exactness of 99.16% with the Adam  streamlining agent. | |