CHAPTER 9
An Analysis of Blind Stick Using Arduino and Ultrasonic Sensor

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ABSTRACT

The Smart Blind Stick scans the path in front of it with the help of an HC-SR04 Ultrasonic sensor. Whenever the sensor detects any object in its path the buzzer starts beeping and also at the same time the LED turns on. The blind person can hear the beeping of the buzzer and manage to change the way. In this way, the person can easily find his way without getting injured. This smart stick works in the same way as the Ultrasonic range finder did. You can also see the real-time values of the distance in cm on the Arduino serial monitor. Once the circuit is ready for this Arduino mini-project tie the whole set-up to a stick using zip tie Generally, this project is wearable with the help of Gloves, rubber band etc. and PCB materials helps to build all the hardware object in it, PCB helps to build good connection between parts, and the main part of this instrument is it is very cheap in cost and easy to carry so it will drastically benefit the community.

Keywords: *Arduino Bases, ultrasonic sensor, PCB materials, etc.*

INTRODUCTION

Handwritten digit recognition is the ability of a computer to recognize the human handwritten digits from different sources like images, papers, touch screens, etc, and classify them into 10 predefined classes (0-9). This has been a topic of boundless-research in the field of deep learning. Digit recognition has many applications like number plate recognition, postal mail sorting, bank check processing, etc [2]. In Handwritten digit recognition, we face many challenges because of different styles of writing of different peoples as it is not an Optical character recognition.

This research provides a comprehensive comparison between different machine learning and deep learning algorithms for the purpose of handwritten digit recognition. For this, we have used Support Vector Machine, Multilayer Perception, and Convolution Neural Network. The comparison between these

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algorithms is carried out on the basis of their accuracy, errors, and testing-training time corroborated by plots and charts that have been constructed using matplotlib for visualization. The accuracy of any model is paramount as more accurate models make better decisions. The models with low accuracy are not suitable for real-world applications. Ex- For an automated bank cheque processing system where the system recognizes the amount and date on the check, high accuracy is very critical. If the system incorrectly recognizes a digit, it can lead to major damage which is not desirable. That's why an algorithm with high accuracy is required in these real world applications.

Hence, we are providing a comparison of different algorithms based on their accuracy so that the most accurate algorithm with the least chances of errors can be employed in various applications of handwritten digit recognition. This paper provides a reasonable understanding of machine learning and deep learning algorithms like SVM, CNN, and MLP for handwritten digit recognition. It furthermore gives you the information about which algorithm is efficient in performing the task of digit recognition.

In further sections of this paper, we will be discussing the related work that has been done in this field followed by the methodology and implementation of all the three algorithms for the fairer understanding of them. Next, it presents the conclusion and result bolstered by the work we have done in this paper. Moreover, it will also give you some potential future enhancements that can be done in this field. The last section of this paper contains citations and references used.

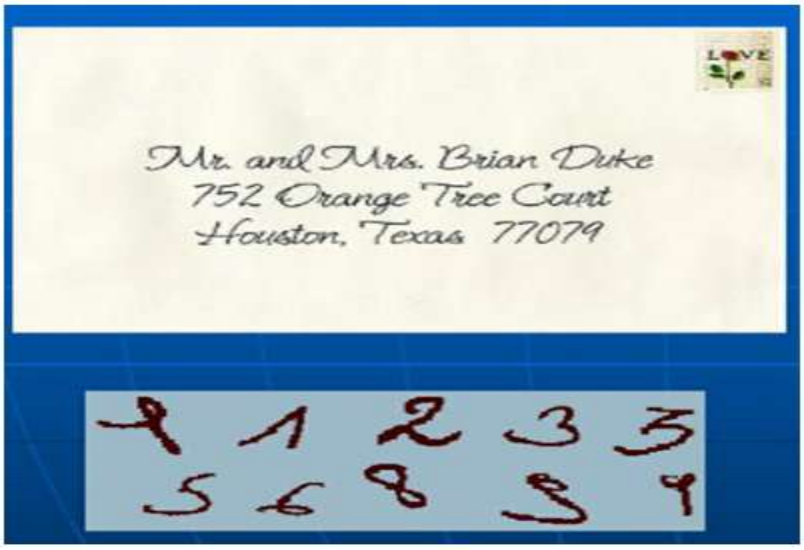

FIGURE 1.1 SAMPLE HANDWRITTEN DIGITS

OVERVIEW

Machine learning and deep learning plays an important role in computer technology and artificial intelligence. With the use of deep learning and machine learning, human effort can be reduced in recognizing, learning, predictions and many more areas. This article presents recognizing the handwritten digits (0 to 9) from the famous MNIST dataset, comparing classifiers like KNN, PSVM, NN and convolution neural network on basis of performance, accuracy, time, sensitivity, positive productivity, and specificity with using different parameters with the classifiers.

Handwritten digit recognition has gained so much popularity from the aspiring beginner of machine learning and deep learning to an expert who has been practicing for years. Developing such a system

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includes a machine to understand and classify the images of handwritten digits as 10 digits (0–9). Handwritten digits from the MNIST database are already famous among the community for many recent decades now, as decreasing the error rate with different classifiers and parameters along with preprocessing techniques from 12% error rate with linear classifier (1 layer NN) to achieving 0.23% error rate with hierarchy of 35 convolution neural networks [Yann LeCun, MNIST database of handwritten digits]. The scope of this article is to compare the different classifiers with different parameters and try to achieve near-human performance.

LITERATURE SURVEY

An early notable attempt in the area of character recognition research is by Grimsdale in 1959. The origin of a great deal of research work in the early sixties was based on an approach known as analysis-by-synthesis method suggested by Eden in 1968. The great importance of Eden's work was that he formally proved that all handwritten characters are formed by a finite number of schematic features, a point that was implicitly included in previous works. This notion was later used in all methods in syntactic (structural) approaches of character recognition.

K. Gaurav, Bhatia P. K. [5] Et al, this paper deals with the various pre-processing techniques involved in the character recognition with different kind of images ranges from a simple handwritten form based documents and documents containing colored and complex background and varied intensities. In this, different preprocessing techniques like skew detection and correction, image enhancement techniques of contrast stretching, binarization, noise removal techniques, normalization and segmentation, morphological processing techniques are discussed. It was concluded that using a single technique for preprocessing, we can’t completely process the image. However, even after applying all the said techniques might not possible to achieve the full accuracy in a preprocessing system.

RELATED WORK

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. With time, machines are getting more and more sophisticated, from calculating the basic sums to doing retina recognition they have made our lives more secure and manageable.

Likewise, handwritten text recognition is an important application of deep learning and machine learning which is helpful in detecting forgeries and a wide range of research has already been done that encompasses a comprehensive study and implementation of various popular algorithms like works done by S M Shamim [3], Anuj Dutt [4], Norhidayu binti [5] and Hongkai Wang [8] to compare the different models of CNN with arXiv:2106.12614v1 [cs.CV] 23 Jun 2021 the fundamental machine learning algorithms on different grounds like performance rate, execution time, complexity and so on to assess each algorithm explicitly. [3] concluded that the Multilayer Perceptron classifier gave the most accurate results with minimum error rate followed by Support Vector Machine, Random Forest Algorithm, Bayes Net, Na¨ıve Bayes, j48, and Random Tree respectively while [4] presented a comparison between SVM, CNN, KNN, RFC and were able to achieve the highest accuracy of 98.72% using CNN (which took maximum execution time) and lowest accuracy using RFC. [5] did the detailed study-comparison on SVM, KNN and MLP models to classify the handwritten text and concluded that KNN and SVM predict all the classes of dataset correctly with 99.26% accuracy but the thing process goes little complicated with MLP when it was having trouble classifying number 9, for which the authors suggested to use CNN with Keras to improve the classification.

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While [8] has focused on comparing deep learning methods with machine learning methods and comparing their characteristics to know which is better for classifying meditational lymph node metastasis of non-small cell lung cancer from 18 F-FDG PET/CT images and also to compare the discriminative power of the recently popular PET/CT texture features with the widely used diagnostic features. It concluded that the performance of CNN is not significantly different from the best classical methods and human doctors for classifying meditational lymph node metastasis of NSCLC from PET/CT images. However, CNN does not make use of the import diagnostic features, which have been proved more discriminative than the texture features for classifying small sized lymph nodes. Therefore, incorporating the diagnostic features into CNN is a promising direction for future research.

All we need is lots of data and information and we will be able to train a big neural net to do what we want, so a convolution can be understood as"looking at functions surrounding to make a precise prognosis of its outcome." [6], [7] has used a convolution neural network for handwritten digit recognition using MNIST datasets. [6] has used 7 layered CNN model with 5 hidden layers along with gradient descent and back prorogation model to find and compare the accuracy on different epochs, thereby getting maximum accuracy of 99.2% while in [7], they have briefly discussed different components of CNN, its advancement from LeNet-5 to SENet and comparisons between different model like AlexNet, DenseNet and ResNet.

The research outputs the LeNet-5 and LeNet-5 (with distortion) achieved test error rate of 0.95% and 0.8% respectively on MNIST data set, the architecture and accuracy rate of AlexNet is same as LeNet-5 but much bigger with around 4096000 parameters and "Squeeze-and-Excitation network" (SENet) have become the winner of ILSVRC-2017 since they have reduced the top-5 error rate to 2.25% and by far the most sophisticated model of CNN in existence.

WORKING PRINCIPLES

Normally handwritten recognition is divided into six phases which are image acquisition, pre-processing, segmentation, feature extraction, classification and post processing. The block diagram of the basic character recognition is shown in below figure.

IMAGE ACQUISITION

Digitized/Digital Image is initially taken as input. The most common of these devices is the electronic tablet or digitizer. These devices use a pen that is digital in nature. Input images for handwritten characters can also be taken by using other methods such as scanners, photographs or by directly writing in the computer by using a stylus.

PREPROCESSING

It is the basic phase of character recognition and it's crucial for good recognition rate. The main objective of pre-processing steps is to normalize strokes and remove variations that would otherwise complicate recognition and reduce the recognition rate. The variations or distortions include the irregular size of the text, missing points during pen movement collections, jitter present in text, left or right bend in handwriting and uneven distances of points from neighboring positions. Pre-processing includes five common steps, namely, size normalization and centering, interpolating missing points, smoothing, slant correction and resampling of points.

SEGMENTATION

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Segmentation is done by separation of the individual characters of an image. Generally document is processed in a hierarchical way. At first level lines are segmented using row histogram. From each row, words are extracted using column histogram and finally characters are extracted from words.

FEATURE EXTRACTION

The main aim of feature extraction phase is to extract that pattern which is most pertinent for classification. Feature extraction techniques like Principle Component Analysis (PCA), Linear Discriminant Analysis (LDA), Chain Code (CC), Scale Invariant Feature Extraction (SIFT), zoning, Gradient based features, Histogram might be applied to extract the features of individual characters. These features are used to train the system [9].

CLASSIFICATION

When input image is presented to HCR system, its features are extracted and given as an input to the trained classifier like artificial neural network or support vector machine [8]. Classifiers compare the input feature with stored pattern and find out the best matching class for input.

POST PROCESSING

Post-processing refers to the procedure of correcting misclassified results by applying linguistic knowledge. Post processing is processing of the output from shape recognition. Language information can increase the accuracy obtained by pure shape recognition. For handwriting input, some shape recognizers yield a single string of characters, while others yield a number of alternatives for each character, often with a measure of confidence for each alternative.

In this project, PTC Web services are used. In this section, I will explain how the PTC web services work. Efficiency improvement that will be applied to the PTC web services required some changes on some of the classes used. Applying more improvements will need more changes on the classes where calculations applied. Details will be explained in the following sections of this report.

CONCLUSION AND FUTURE SCOPE

Thus, this project which is built by our group is totally tells us about the architecture and model of Arduino based third eye or extra vision for blind people. A simple architecture device, efficient in use, cheap in cost, easy to carry with us, easy configurable, easy to handle electronic guidance system with proper and easy usages guidance and various effective hardware helps to provides the amazing properties so that it helps the needy blind people. So, talking about this project it has the feature to detect the distance of objects that’s are major issue for blind people after detecting the object distance they also told us about the direction where object was detected like left, right, top, bottom. This all feature helps the blind person to easy walk in any direction without colliding with obstacle. With our given project instruction if it is made as accurate as we were showing in our research paper that helps the blind people to move in any direction without taking the third person help it also makes someone independent from the others and if they have some work so they do by itself. Our project is successfully removing the problem of existing navigation techniques like carry the stick with us while walking, use of another person while moving one place to another and many more issue was successfully resolved by this project. This project, if used on a wider scale and distributed to all the blind people it really makes a bigger impact to the society and the community.

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