Model for Handwritten Recognition Based on Artificial Intelligence

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***Abstract*—This paper proposed a general algorithm for more efficient handwritten recognition. Using handwritten recognition algorithms can reduce the time it takes to convert documents into letters for reducing the workload. The handwritten fonts used in this thesis are multi-script, which consists of Bangla font, Latin, MNIST handwritten alphabet series on prescription. This step has been designed and developed with genetic algorithms in conjunction with artificial intelligence techniques. The result of this algorithm was designed and developed to produce accurate results in the recognition of the Bangla set is 94.05 %, Latin 98.58 %, and MNIST 100 %.**

Keywords— handwritten, recognition, genetic algorithm, artificial intelligence, multi-scripts

I. INTRODUCTION

Handwritten Recognition (HR) is a challenging issue in the field of pattern recognition and artificial intelligence. [1] [2] [3] and [4]. These methods facilitate the translation of various forms of correspondence such as letters, postcards, history, inscriptions, Bai Lan books, newspaper texts, and other documents are not limited. The handwriting complexity is classified into three levels, simple, moderate and difficult, as shown in Fig. 1 to Fig. 3, respectively. From the research to develop a handwriting recognition system that is challenging. [5] and [6], and has over 1,000 images of lilac images [7] to transform the leaves into digital form. However, it was found that only a partial leaf only. Most of the Bai Lan inscription textbook. Ancient traditions historic local and other valuable histories are in damaged condition and some are destroyed due to storage. This is another reason why researchers around the world recognize the importance of recognition. The interpretation of the handwriting character by developing techniques and methods such as improvement of character classification techniques. The accurate and rapid classification for accurate information retrieval [8], sound classification [9], stock price forecasting [10]. The relationship between laboratory findings in a hospital, medications and problems of patients [11].

Handwritten Recognition System (HRS) are also widely used in business circles, such as bank checks [12], postal postcards [13] and postal code recognition [14]. Benefit from this research. [15, 16]. Identification refers to the process of identifying writers and examining them. Validate documents It is widely used, such as the court of justice, and for the automatic signature of applications for banking transactions.

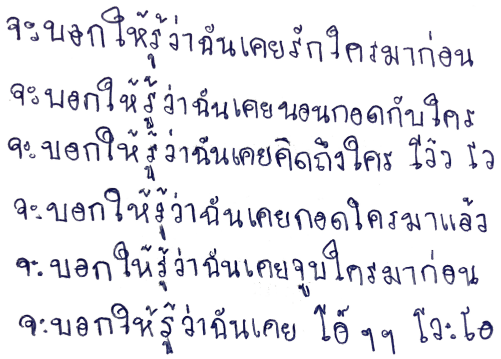

Fig.1. A sample of handwritten.

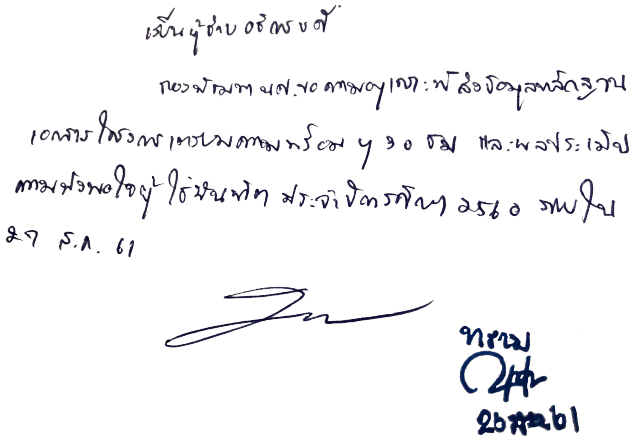

Fig.2. A moderate of handwritten.

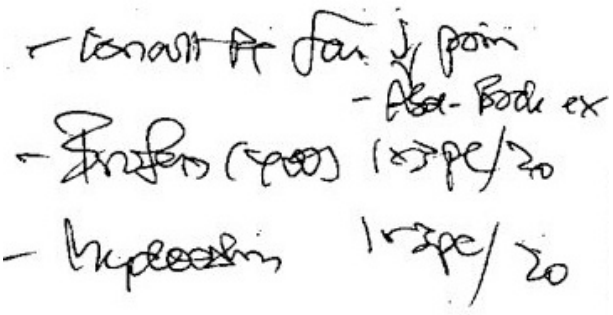

Fig.2. A difficult of handwritten.

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II. RELATED WORKS

A. Data set

Bangla or Bengali is the second most popular language in India and Bangladesh as show in Fig.4 and is the fifth most used language in the world [17].

Fig. 4. The variety in the writing style of Bangla's handwritten data series.

Latin handwriting character data set was prepared by der Maaten [18]. The original image was compiled by Schomaker and Vuurpijil for identifying the forensic names and using the Firemaker data set as handwritten notes with Dutch characters as show in Fig. 5.

Fig. 5. Example of Latin character data set.

The MNIST data set is a subset of the NIST data set [19], a digitized image that is scaled to the standard and centered on a handwritten static size image. The image is 28 × 28 pixels, with handwritten images of the MNIST data set with grayscale.

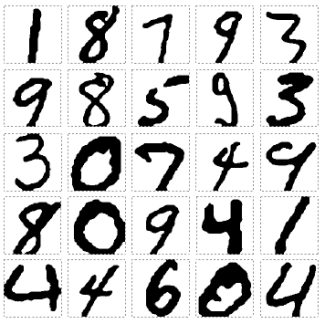

Fig. 6. Example of MNIST character data set.

B. Support Vector Machine: SVM

The SVM algorithm is invented and invented by Vapnik [20]. It is intended to be applied to many types of recognition problems.

Linear SVM problems for two sets of data. The SVM algorithm is very useful for two classification problems. The algorithm will find the best hyperplanning, with the maximum distance at the training point close to the hyperplane. The training point closest to the split hyperlink is called the original SVM support vector, a linear binary classification, which is useful for two-level classification problems. On the other hand, poor separation for complex data is not disrupted. For example, image data now describes the SVM as D a training set.

$$D = \{(x_i, y_i), 1 \le i \le M\} \tag{1}$$

$x_i \in R^N$ is a vector input. $y_i \in \{+1, -1\}$ is a binary format. The best model from a set of hyperplanes R^N calculated by the SVM optimization algorithm, decision functions are provided.

$$f(x) = sign(w^T w + c\sum_{i=1}^{n} \varepsilon_i \tag{2}$$

when w is a weight vector that is perpendicular to the hyperplane and b is a bias value. To calculate the value w and b the SVM algorithm reduces the following functions:

$$J(w, \varepsilon) = \frac{1}{2} w^T w + c\sum_{i=1}^{n} \varepsilon_i \tag{3}$$

Subject to restrictions:

$$w^T x_i + b \ge +1 - \varepsilon_i \ for \ \ y_i = +1 \tag{4}$$

and

$$w^T x_i + b \le -1 + \varepsilon_i \ for \ y_i = -1 \tag{5}$$

when C control errors between training errors and general conclusions $\varepsilon_i \ge 0$ is a weak variable that can tolerate some errors but must be minimized while this soft edge method is used to fit a complex data model. If used incorrectly, over fitting can occur. The maximum difference separates the hyperplanes $w^T x + b = 0$. Hyperplanine separates the largest distance to the closest plus $w^T x + b = +1$ and negative $w^T x + b = -1$ linear kernel functions are defined as follows.

$$K(x_i, x_j) = x_i^{\ T} x_j \tag{6}$$

Non-linear SVM issues for multiple groups. The SVM linear algorithm is extended to deal with non-linear multivariate classification problems by creating and combining multiple binary identifiers. [106] It offers nonlinear kernel functions. Many matches In this topic, the researcher selects the basic function Radial Basis Function (RBF) as a non-linear similarity function in the SVM classifier. The RBF kernel calculates the similarity between the two inputs as (7).

$$K(x_i, x_j) = \exp(-\gamma \left\| x_i - x_j \right\|^2) \quad (7)$$

when γ as the kernel parameters of the RBF kernel, the value of a lot of parameters can cause over fitting due to the increase in the number of SVM.

III. PROPOSE METHODOLOGY

In this paper, we investigate the appropriate method for developing a new algorithm for handwriting recognition based on the conceptual framework of research.

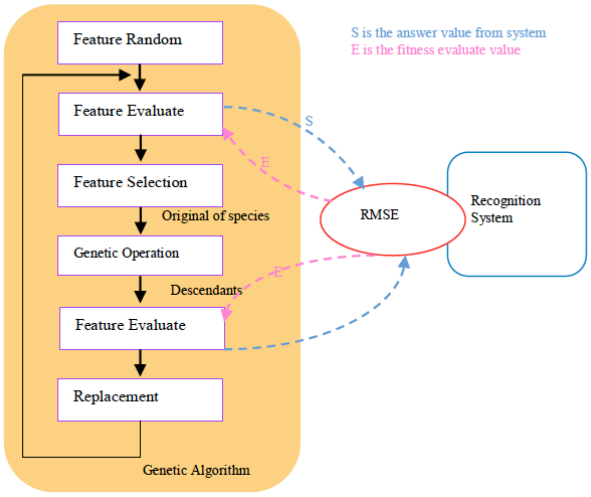

Fig.7. Flow chart of feature selection with genetic steps.

The details of the process diagram can be described as follows:

Step 1: Start with random pairing of feature.

Step 2: Evaluate the chromosome feature group with the objective function. Because the system can not understand the chromosome value within the genome, it must decode it before calculating the RMSE.

Step 3: Calculate fitness function and then give feedback to GA.

Step 4: Use the appropriate chromosome selection to determine the origin of the species. It is used to represent the next generation.

Step 5: The origin of the breed was created by genetic work. Chromosomes in the genome are present.

Step 6: Calculate the chromosomes of the offspring. (Use the same procedure as in step 3)

Step 7: Chromosomes in the population are replaced by descendants of step 5. Some specific features are replaced by judges with impaired values.

Step 8: Start repeating from Step 2 until the answer is right. The answer must come from the best chromosome in itself which can be used to evaluate the value of the required RMSE answer.

Finally, in the experiment and the results show more accurate results of this system compared to the normal SVM algorithm.

A. *Chromosome Encoding*

Genetic algorithms meet the answer from the population. Individual answers are specific to the chromosome or genome. The details and procedures can be described as follows.

Chromosome Encoding Scheme is the first important step in genetic algorithms. It was designed for using chromosomes as a response agent from the system. In this study, a set of 100 chromosomes represents a set of 100 extracted features, defined as (8).

$$A = [a1, a2, a3, \ldots an] \quad (8)$$

when A is the chromosome representation of the handwriting feature described above, and each i, $i = 1, 2, 3, \ldots, n$ is the answer to each variable in the system and the coding algorithm.

B. *Fitness Function*

Fitness function is a function for evaluating the behavior of the algorithm designed by the researcher as a target value. The purpose of this function is to determine the suitability of each chromosome between group and chromosomal arrangement. These are used as gauges. Selected for the chromosome used in descent in the next version. Accuracy of character recognition is the exercise function for this document.

$$f = 100 - \%\ Error \quad (9)$$

when

$$\%Error = Relative\ error\ x\ 100 \quad (10)$$

$$Relative\ error = \left| \frac{x_{mea} - x_t}{x_t} \right| \quad (11)$$

where x_{mea} is the value of character recognition.

x_t is the number of characters to remember.

The suitability of each chromosome will be utilized in the various stages of the genetic algorithm in the next section. The next section discusses the selected chromosomes, which are key criteria for selecting the appropriate features.

C. *Selection*

This is a random selection of subgroups. The population and the strongest population in the subgroup will be selected. The next The selection method in this document uses the tournament selection method.

D. *Uniform crossover*

Randomly selected population and crossed after the selected location from random or exchange. In this research, Uniform Crossover is used. The point on the chromosome may be the cutoff point and the crossover mask is used to aid the crossover uniformity. The mask is a binary type and size is the number of bits equal to the length of the chromosome. The value of the mask in different positions indicates the crossover between the origin of the species.

E. Mutation

Mutations are genetic algorithms that can be avoided by the optimal answer to the best local results by preventing the change in the chromosome population in the same way as at that point. Probability of mutation 0.1

$$m=1/n \tag{12}$$

where n is the total number of attributes of the handwriting feature. The details of the genetic process.

IV. EXPERIMENTAL AND RESULTS

Based on the research process described in later, the researcher tested the efficiency of the algorithms and techniques presented. By finding the accuracy of the proposed algorithm, in reporting this section. This papers deals with recognizing handwritten characters from 3 groups of characters from different authors written based on artificial intelligence. The challenges of these characters are similar in some classes. Bangla is the second most popular language in India and Bangladesh. The Bangla Handwriting Handbook consists of 45 classes and 4,627 classes for the training set and 900 examples in the test suite. Latin handwritten characters are written in Dutch. 251 writers have 37,616 handwriting characters, 26,329 practice examples and 11,287 sample samples. MNIST data sets are large databases of numbers. Handwriting is often used for training image processing systems. The image size is 28 × 28 pixels.

TABLE I. SUMMARIZES HANDWRITTEN DATA SERIES

Data set	Class	Training set	Testing set
Bangla	45	4,627	900
Latin	25	26,329	11,287
MNIST	10	60,000	10,000

Evaluation the handwritten character recognition system to recognize or show measured values close to actual values. Calculate the accuracy / precision using as equation (13).

$$\% \, Accuracy = 100 - \% \, Error \tag{13}$$

This paper compared the method for selecting features in handwritten scripting scripts using SVM, kNN, and MLP as classifiers. Comparison of handwriting Bangla Latin and MNIST. The results of the classification accuracy are shown in the table II.

TABLE II. ACCURACY RATES USING 3 HANDWRITTEN CHARACTER SETS FROM THE COMPARISON (%) OF THE SVM, KNN, AND MLP

Data set	Accuracy rate		
	SVM	kNN	MLP
Bangla	94.05	85.60	90.50
Latin	98.58	96.31	93.79
MNIST	100.00	95.11	99.48

From Table II the three data sets of handbook items were tested using the popular algorithm for character recognition. The *k*-Nearest Neighbor (*k*NN) and multi-layered Perceptron (MLP) support algorithms show that each handwriting recognition algorithm is The accuracy of handwriting recognition MNIST data set with SVM is 100.00% accurate because the handwriting set is a clear figure. The overlap is minimal. Therefore, the SVM recognition can be recognized. When considering the three types of recognition accuracy with the handwriting set, The SVM can provide the most accurate recognition of data. Therefore, in this research, support vector machines (SVM) are used for character recognition.

V. CONCLUSION

This papers aims to develop new algorithms for handwriting recognition systems. This study uses a set of alphabetical images, which are commonly used in the present case for character recognition. The three sets of data are Bangla Latin and MNIST, which are popular handwriting characters. Recognition algorithm Based on the results of this handwriting recognition algorithm. Researchers have designed and developed an algorithm based on the principle of digital image processing to provide image data for processing. Various images used in this experiment are divided into series. The first set was the Bangla Latin MNIST font set in a test to measure the effectiveness of this research. Note that the test image is a well-formed font between the text and the background. And the background of the picture is white. Then, the extraction process was performed to determine the density of pixels according to the principle of image processing. Genetic algorithms were used to analyze the extraction of handwriting features before they were introduced into the recognition.

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