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Siam Technology Press, Srisakdi Charmonman Institute, Siam Technology College

**Front Door of
Srisakdi Charmonman Institute**

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**The Desk of
Prof. Srisakdi Charmonman**

**Another View of the Office of
Prof. Srisakdi Charmonman**

Siam Technology Press

Srisakdi Charmonman Institute,

Siam Technology College

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Siam Technology College of Thailand
In Collaboration with

The Interdisciplinary Network Foundation for Research and Development

The Computer Association of Thailand Under the Royal Patronage of HM the King (CAT)

Srisakdi Charmonman Institute

Association of Asia-Pacific Federation of Internet of Things

Thailand Chapter of the Internet Society

Thailand Internet Association

Thailand Chapter of the ACM

The Association of Thai Internet Industry

Thailand Chapter of the Computer Society of the IEEE

Asia-Pacific eLearning Association

The Internet Poll Association

The Association of Thai Federation of Information Processing

FOREWORD

I am very pleased to see that the Volume 26, Number 2 of IJCIM includes selected papers as proof of our ongoing commitment to serve the community of researchers. We will continue to collaborate to making our journal better. Please carefully look at guidelines about paper format at www.ijcim.th.org and send your papers on topics of current interest in computer sciences, Internet technologies and management for the upcoming issues to me (charmonman@gmail.com). I will get your paper reviewed by experts in your field. If the initial response is favorable, I will request you to submit your camera-ready final paper as soon as possible for publication in the next edition of IJCIM.

The first paper titled "A Revolutionizing Supply-Chain Management" is written by **Donia Damak from Tunisia**. This paper presented the importance of E-commerce and define it and examines its major elements that link organizational system, due to Electronic commerce (EC) is possibly the most promising application of information technology witnessed in recent years, which was revolutionizing supply-chain management and has enormous potential for manufacturing, retail and service operations.

The second paper titled "Spectrum Allocation and Licensing of Internet of Things (IoT) in Thailand" is written by **Settapong Malisuwan, Wassana Kaewphanuekrungsi (Thailand), and David William (USA)**. This paper belonged to the Internet of Things (IoT) which involved people, businesses, and society, especially the issues involving telecommunications and the required regulation of the IoT system which currently widespread in various countries around the world and would enhance the communication capacity of various devices.

The third paper titled "An E-Learning Model Combining Moodle Program and Social Networks to Enhance Distance Learning" is written by **Chusak Narkprasit (Thailand) and Sorin M. Popovici (France)**. This paper aimed to develop an eLearning model combining Moodle with Facebook as a tool to enhance distance learning by conducting the research through the third year students of Faculty of Education as the sample group, which consisted of 20 students from the division of Educational Technology & Innovation as the experimental group, and 105 students from the division of Early Childhood Education as the control group. The result represented the behavior, trend and attitude toward social network.

The fourth paper titled "Success of Clothing Retailers through Online Channel Using Digital Marketing" is written by **Noppadol Tiamnara and Kanyamon Inwang (Thailand)**. This paper studied the success of clothing entrepreneurs who use online channels to sell their products through digital marketing in Bangkok area, especially the increasing trend of Thailand to improve traditional and online clothing retailers by focussing on the features of online clothing retailers, and the aim of this research was to study the features of clothing retailers, characteristics of clothing retailers' perception, and the information concerning business organizations which take part in the success of online clothing retailers.

The fifth paper titled "Causal Model of Variables by Bayes Theorem" is written by **Aryut Ruangtong, Somchai Prakancharoen, and Nalinpat Porrawatpreyakorn (Thailand)**. This paper proposed to create a causal model and a coefficient of correlation between each independent variable using Bayes Theorem, to find a logical relationship by applying Pearson Correlation technique, and to find for a coefficient of correlation between cause and effect variables.

The sixth paper titled "The Making of an Ideal Alliance Partner: the Perceptions of Singapore Managers" is written by **Nanda Lal Banik (Bangladesh) and Sumit Kumar Bhalla (Thailand)**. This paper was identified a comprehensive set of factors used for selecting strategic alliance partners, and to determined the relative importance according to each of these factors in the partner selection process by applying a questionnaire survey for gathering perceptual data from managers regarding desired attributes in joint venture partners, total 179 companies located in Singapore.

The seventh paper titled "The Proposition of an Online Collaboration Model Using Systems Thinking to Develop Leadership of Agricultural Undergraduate Students" is written by **Thanat Samanakupt, Noawanit Songkram, and Pichai Thongdeelert (Thailand)**. This paper was to develop an online collaboration model using systems thinking to develop the leadership of agricultural undergraduate students by dividing into two phases include the study of the effects of the online collaboration model and the proposition of the online collaboration model by using 46 undergraduates from the Faculty of Agriculture at Kasetsart University as the samples.

The eighth paper titled "RFID Utilization through Supply Chain Management and Logistics Performance" is written by **Sirichai Kingside, Natnarong Jaturat, and Chanongkorn Kuntonbutr (Thailand)**. This paper aimed to study the adoption of RFID (Radio Frequency Identification) in the operation of automotive parts industry in Thailand in order to increase the potential and effectiveness in supply chain and logistics management by using 99 manufacturing firms in automotive parts industry in Thailand as the sample group to conduct the research through the questionnaire.

The ninth paper titled "Asset Supply Chain Management Process with the Internet of Things for Good Governance for Higher Education Institutions" is written by **Watjanarat Kuandee, Prachyanun Nilsook, and Panita Wannapiroon (Thailand)**. This paper proposed to study the asset supply chain management process for higher education institutions, to design a holistic view of the asset supply chain management process for higher education institutions, and to design a conceptual framework of asset management for good governance with IoT for higher education institutions, and the sample consisted of thirty-one experts, each of them have more than five years' experience in asset management and information technology which were selected by purposive sampling.

The tenth paper titled "The Development of Learning Organization Model for Cooperate University in Thailand" is written by **Pakorn Akkakanjanasupar (Thailand), David B. Hopkins (USA), Hemanta Raj Dahal (Nepal), and Neha Khetrapal (India)**. This paper focussed on the development of learning organization model for cooperate universities in Thailand, by applying mixed methods of research methodology which were assigned into 3 phases: qualitative for first and third face and quantitative for the second face, and each face used different population, sample, instrumentation, data collection, and analysis.

The eleventh paper titled "A Conceptual Model of Big Data for Electrical Energy Management in Smart City" is written by **Natthaphong Luangnaruedom, Narongrid Yimcharoenpornsakul, Pradit Songsangyos, and Manyad Limoransuksakul (Thailand)**. This paper proposed to design the Conceptual model of Big Data for Electrical Energy Management in Smart City, as the Smart City was the new age technological system for management and administration the facilities system by controlling with Information technology.

The twelfth paper titled "E-Learning Course Characteristics and User Satisfaction" is written by **Duangta Duangekanong, Somsit Duangekanong, and Thanawan Phongsatha (Thailand)**. This paper was to study the effect of course characteristics on e-learning user satisfaction, and conducted in the context of a workplace training course at an industrial manufacturing firm in Thailand. A user satisfaction survey was used to evaluate the performance of the e-learning system across the firm (n = 278).

The thirteenth paper titled "A Thai 7th Grade Needs Assessment Analysis for Creativity Skills Curriculum Development" is written by **Prasanta Somintara, Aukkapong Sukkamart, Paitoon Pimdee, Pichai Sodbhiban, and Lertlak Klinhom (Thailand)**. This paper was proposed a curriculum development needs assessment analysis of Thai 7th grade students' creativity abilities by using multistage random sampling to select 476 Bangkok area Thai teachers and administrators, and analysis was conducted from the needs assessment questionnaire, from which data was obtained concerning curriculum development and the techniques for strengthening 7th grade student.

The fourteenth paper titled "The Management of Quality Assurance System of Thai Private Hospitals" is written by **Khannaphot Kangpanishkul (Thailand)**. This paper was proposed to review the quality assurance management of Thai private hospitals, due to the quality of medical services must be taken consideration and prominently regarded as the most important factor in management of quality assurance system, because such services play vital roles in representing of its reputation, image, credibility, and achievement with highly trained medical specialists, in particular.

The fifteenth paper titled "Communication Protocol Model for Language Game with Multi-Agents and Multi-Languages Using Dynamic Radius of SOM" is written by **Somjin Juntarajessadakorn, Vatinee Nuipian, and Phayung Meesad (Thailand)**. This paper demonstrated how autonomous systems can learn and communicate with each other in three different humane languages by proposing a conceptual model based on Language Games and Conceptual Spaces.

The sixteenth paper titled "Information Technology Utilization of Undergraduates Faculty of Accounting, Bangkokthonburi University" is written by **Chalida Linjee, Supatra Chantanasiri, Supaporn Boon-Iam, and Nisarat Viangsutorn (Thailand)**. This paper was to study the information technology utilization of undergraduate students, Accountant faculty, Bangkokthonburi University by using The questionnaire as the tool to collect data from 254 undergraduate students at Bangkokthonburi University, and on-way analysis of variance was used as the analysis method.

The seventeenth paper titled "Components Desirable Leadership Characteristics of Undergraduate Students: Document Research" is written by **Suttilug Choonprawat, Malai Thawisook, and Tanin Rattanaolarn (Thailand)**. This paper aimed to analyze the leadership components of undergraduate students by using qualitative methods to collect and analyze secondary data, and the results showed that the leadership components of undergraduate students consist of heart, head, hand, and health.

The eighteenth paper titled "Automatically Algorithm for Physician's Handwritten Segmentation on Prescription" is written by **Narumol Chumuang and Mahasak Ketcham (Thailand)**. This paper proposed a novel approach for physician's handwritten text region detection algorithm based on the threshold and the basis of 4 and 8-connected component, as the handwriting style of people are privacy. Especially, the physician's handwritten is unique and particular word like medical name, symbolic, symptoms of disease.

The nineteenth paper titled "Requirements of E-Learning for Learning Management of Teacher and Student in General Education" is written by **Kattakamon Pislae-Ngam, Thiyaporn Kantathanawat, and Paitoon Pimdee (Thailand)**. This paper reviewed that e-Learning is an innovative approach to learning and more important role of all the technologies in the supporting collaboration, document management and knowledge management, therefore proposed to study requirements of e-Learning for learning management of teacher and student in General Education, and The Samples consisted of 30 teachers and 320 students, selected by stratified random sampling technique who registered in General Education, first semester academic year 2017.

The twentieth paper titled "Application of PIMOGA for Optimization to Upgrade Drainage Gates in Network" is written by **Prudtipong Pengsiri (Thailand)**. This paper presented the application of PIMOGA method (Partition of Initial Population for Multi-objective Genetic Algorithm) for optimization to upgrade drainage gates in network.

The twenty-first paper titled "Palm Leaf Manuscript Segmentation and Reading by Using Artificial Neural Networks" is written by **Thanannath Phattharachairawee, Montean Rattanasiriwongwut, and Mahasak Ketcham (Thailand)**. This paper presented a palm leaf manuscript's Isan Dhamma characters segmentation and reading conducted by using image processing, and the objective was to utilize the obtained data in sentence recognition process further. The input was digital photos of a palm leaf manuscript written with Isan Dhamma characters that was proposed to be adjusted on its quality by adjusting light intensity through histogram.

The twenty-second paper titled "A Development of Constructionism Learning Skills Model for Internship Student Teachers in Thailand" is written by **Sirikanya Netrthanon, Sirirat Petsangsri, and Paitoon Pimdee (Thailand)**. This paper proposed to develop the constructionism learning skills model for internship student teachers in Thailand, by exploring the model of teaching process and observing the experimental teaching of the internship student teachers at faculty of Industrial Education and Technology, King Mongkut's Institute of Technology Ladkrabang, and the data were collected via 4 steps.

(Prof. Dr. Srisakdi Charmonman)
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CONTENTS

Palm Leaf Manuscript Segmentation and Reading by Using Artificial Neural Networks

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Abstract - Palm leaf manuscript is considered as a kind of cultural heritage and the record of local wisdom of ancestors that should be transformed into digital format for educational and research benefits of the next generation. This research presents palm leaf manuscript's Isan Dhamma characters segmentation and reading conducted by using image processing. The objective of this research is to utilize the obtained data in sentence recognition process further. The input was digital photos of a palm leaf manuscript written with Isan Dhamma characters that was proposed to be adjusted on its quality by adjusting light intensity through histogram. Subsequently, its quality was improved by using median filter in order to screen data on enhancement or attenuation of some picture's properties in order to gain quality as demanded. Subsequently, characters were segmented from background (segmentation) by using Global Thresholding. In the next process, Principal Components Analysis (PCA) was used in order to match each sentence with its features. In the last procedure, obtained features were compared with database in order to find range of such sentence by using the principles of neural network before comparing with support vector machine in order to compare such sentence with database. Based on the experiment conducted with 10 images of palm leaf manuscript, it was found that neural network gave better results than support vector machine by 86%.

I. INTRODUCTION

Digital Age is originated from technological advancement including computer technology, communication technology, and information technology. Consequently, the growth rate of information has been changed rapidly. The format of information would be in message, image, and sound formats and such information has been collected in digital formats. Consequently, it is convenient for retrieval and application as demanded. However, there are some types of information that are collected in document format without transforming to digital format therefore it is difficult for retrieval and practical utilization. Consequently, knowledge on image processing is adjusted in order to adjust document to be digital image and operated with Optical Character Recognition (OCR) for transforming digital image to be digital document. To transform digital images to be in electronic document format, it is necessary to utilize knowledge on image processing and Optical Character Recognition (OCR).

Thai character recognition can be applied to several businesses, for example, news reporters are able to record all interviews on paper or students are able to summarize their study on notebooks. Subsequently, they input such

paper into OPCR system and the system will transform characters to be in the form of character process program. Consequently, it is not necessary for news reporters and students to type all characters repetitively. This helps to reduce and accelerate work process. Thai handwriting character recognition program can be applied to many devices, for example, electronic whiteboard or PDA for online operation, for example, when writing on electronic whiteboard, program will be able to be transformed in the form of character processing program leading to higher operational efficiency.

Generally, the principles of Optical Character Recognition are different upon the target languages because each language has distinctive format. For recognition technology, Dhamma characters have been developed to support recognition of various sizes and fonts of characters in order to improve accuracy on recognition from Thai language directly, especially in the form of similar Dhamma characters. Researches related to Dhamma character recognition proposed the learning methods based on various characters, for example, Back-Propagation Neuron Network (BPN), Time-Delay Neuron Network (TDNN), or Fuzzy Logic, etc.

II. LITERATURE REVIEWS

In this paper, we proposed the methods for Segmentation and Reading by Using Artificial Neural Networks.

The major procedure related to character recognition is object segmentation. According to literature survey, it was found that there was a number of methodology used for segmentation. Khankasikam et al, [1-2] proposed histogram technique in order to sharpen pixels. Wantanable et al, [3-4] proposed different histogram technique by selecting different numbers of grey scale. This methodology utilized data related to neighboring pixels or the edge of the existing image in order to adjust for the benefits of Thresholding and another method was histogram administration. Di Gesu [5], [3] proposed the use of considered light intensity and spatial data for data input in order

to improve non-linear operational efficiency [6-7]. Moreover, there was some effort to use fuzzy logic [8] and artificial neural networks [9] for character recognition. W. et al, [10] mentioned Automatic License Plate Recognition (ALPR), i.e., extraction of data on vehicles from images or image orders of extracted data can be used with or without database on inspection of venous system for traffic monitoring. ALPR uses either black and white or infared camera for using the image. Ntirogiannis et al, [11] studied that Binarization of document image is very important in analyzing and recognizing document image because it affects to the following procedures of recognition process. Evaluation of Binarization also helps to study on its algorithm behavior as same as to inspect its efficiency by providing qualitative and quantitative identification of performance. This paper focused on pixels evaluated by using Binarization for handwriting / Historical Document Printer in the form of evaluation proposing retrieval and accuracy. Evaluation measures were amended correctly by using lower weighing that may lead to bias against evaluation. Chattopadhyay et al [12] conducted a complex operation in video. OCR system was proposed to be operated on embedded platform. The novelty of proposed method was the use of processing circuit and low memory unit to provide correct recognition by 84.23% that was higher than OCR video. The correctness was normally accepted. Malakar et al. [13] explained that extraction of message line is one of the important procedures of accepted Optical Character (OCR) system. In the event of document image written by handwriting, appearance of line twisting or overlapping (s) making this process to be challenging process of current research techniques extracted from 87.09% and 89.35%, respectively. Sankaran et al [14] proposed a project that was accepted on India's Devanagiri script. Correctness of Devanagiri script recognition is unable to be compared with Roman script due to complexity of script writing style. We solved this problem by using well-known artificial neural networks as the Bi-directional Long Short-Term Memory (BLSTM). Sankaran et al [14] reported that error rate was reduced over than 20% and

characteristic of error rate was lower than 9% compared with the best OCR system.

This paper is divided into 5 parts. The second part is explanation on standards and procedures / methods used on paper for enhancing efficiency and segmenting characters while the third part is explanation on preparation of data presentation. The forth part is explanation on recognition methods while the fifth part is explanation on results and conclusion.
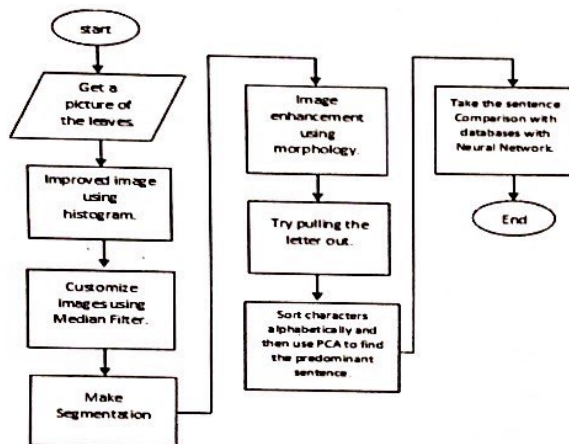
Fig. 1 The Proposed Method

III. LEADERSHIP STYLES

Segmentation and Reading by Using Artificial Neural Networks.

A. Preparation of Image Data

This research presented the method for collecting data obtained from stored documents in the form of image file of 50 images of the characters used as the sentences and its file name extension was Joint Photographic Experts Group (JPEG) with the sizes ranged from 320x240 to 2048x1536 pixels with white characters and black background.
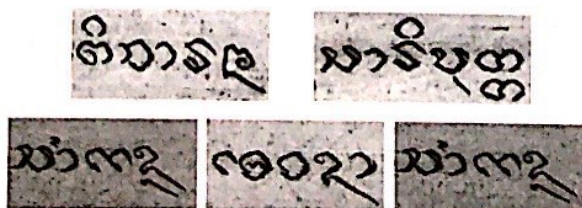
Fig. 2 Sample Images Used in Testing

B. Median Filter [15-16]

Firstly, images are enhanced by using median filter through spatial convolution with the weight of 1 thoroughly. After conducting spatial convolution, the outcome is averaged by selecting mean as shown in the equation below:

$$g(i,j) = med[x(i+r, j+s) \in A(i,j) \in Z^2] \quad (1)$$

Whereas, median filter is a kind of non-linear filtering and the advantage of image enhancement through median filter is image blurring giving the same tone of pixel's intensity.

C. Global Thresholding Technique [17]

In this procedure, background was segmented from foreground by Thresholding with the intensity between both thresholds of Histogram whereas the obtained Threshold was ranged between 0-255 only. Threshold was used for comparing values of each pixel. If f(x,y) is less than Threshold, such pixel will be adjusted as black or object part. If f(x,y) is higher or equal to Threshold, such pixel will be adjusted as white or background that can be written as the following equation:

$$f_{thr}(x,y) = \begin{cases} 1, f_f(x,y) < Threshold \\ 0, f_f(x,y) \geq Threshold \end{cases} \quad (2)$$

Whereas,

1 is black that is the part of object
0 is white that is the part of background

D. Morphology [18-19]

In the following procedure, noises were removed by using image corrosion technique in order to decrease the area of white color or object in the image. The processing procedures were the same as those of image expansion but there was difference based on the principles stated that all positions with factors moving would be compared with images.

$$A \ominus B = \{z \mid (B)_z \subseteq A\} \quad (3)$$

Whereas,

A is the image requiring corrosion of image border;

B is structural elements;

Z is pixel field

Fig. 3 Image after Enhancing with Morphology

E. Extraction of Features of Each Sentence

In this paper, Principal Components Analysis (PCA) was used for extracting features of each sentence in order to be used for recognizing sentence. This will help to recognize the scope of word. To analyze on the major elements, it is necessary to prepare images for analyzing and face recognizing. The procedures are as follows:

- **Instructional Procedures**

1. Determine face of I(x,y) as Array 2 Dimension, N x N images. Moreover, it may be considered as vector of N^2 dimension.

2. Build new body with the size of 2-D image from N x N pixels, it will be 1-D vector in N^2 dimension.
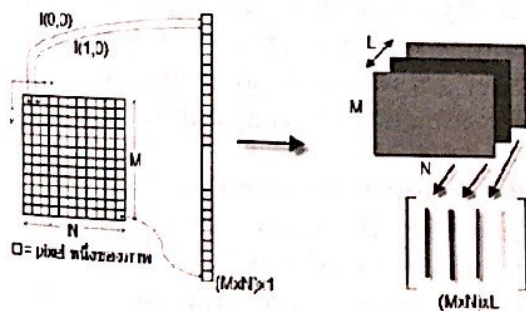
Fig. 4 Results of Vector Transformation from 2D to be 1D

3. Check vector of mean of deviation from mean and matrix of co-variance for instructional collection, especially, images in instructional images will be represented by $\{T_1, T_2, ..., T_M\}$ whereas each T_M is vector of N^2 dimension with M value as the number of images in instructional collection. The example of mean vector is as follows:

$$\varphi = \frac{1}{M} \sum_{n=1}^{M} T_n \qquad (4)$$

4. The collection of vectors was deviated from mean $\{\Theta_1, \Theta_2, \Theta_3, ..., \Theta_M\}$ with difference of each individual of instructional images from each mean vector.

$$\emptyset_i = T_i - \varphi \qquad (5)$$

5. Check eigenvectors of the matrix of variance of instructional collection. The matrix of co-variance will be obtained.

$$C = AA^T \qquad (6)$$

Whereas,

$$A = [\Theta_1, \Theta_2, \Theta_3, ..., \Theta_M]$$

6. Check eigenfaces eigenvectors as v_2 of such $A^T A$ whether:

$$A^T A v_i = \mu_i v_i \qquad (7)$$

- **Test Procedures**

7. Transform images for testing as eigenfaces based on the aforementioned method. Subsequently, those images will be minus with the mean of images in order to find differences of images. The obtained differences are multiply with Eigenvector.

8. Calculate distance between tested faces and image groups used in learning. Subsequently, find the distance with proportion that is similar with image group used in learning by finding the shortest distance.

$$d(Y_1, Y_2) = \sum_{k=1}^{d} \left\| y_k^1 - y_k^2 \right\|^2 \qquad (8)$$

Whereas,

$\left\| y_k^1 - y_k^2 \right\|^2$ is Euclidean distance between two feature vectors.

F. Recognition

• Support Vector Machine [20-21]

The method of Support Vector Machine is classification with Supervised Learning that is classified as the technique used for solving the problem on data format recognition based on the principles of calculation of coefficient of equation in order to create Optimal Separating Hyper Plane.

Fig. 5 Optimal Separating Hyper Plane from SVM

$$f(x) = sign(w.x + b) \qquad (9)$$

Whereas,

w means weighing vector of recognition obtained from weighing process.

B means bias for recognition system.

X means Feature Vector.

Sign means +1 when value is higher than 0 and -1 when value is lower than 0.

• Artificial Neural Networks [22-23]

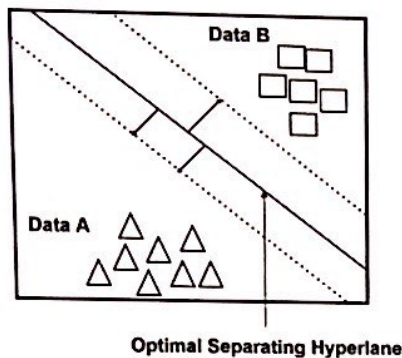Learning of Perceptron network is in the manner of layered structure and learning data will be input in the first layer that is Input Layer. After calculating the first layer, it will be sent to the Hidden Layer whereas each unit of this layer will accept data from all units in the former layers for calculating and sending to the next layer. When data is sent to the last layer or Output Layer, the input will be given by the system. This kind of data transmission is considered as feed forward. Subsequently, the output will be checked by the system how it is incorrect based on the target. In this research, we utilized instructional algorithm for using with artificial neural networks based on Backpropagation technique. This technique is the use of layered structure of Supervised Learning with demanded target and adaptive networks were used for adjusting the weight properly as shown in Fig. 6.
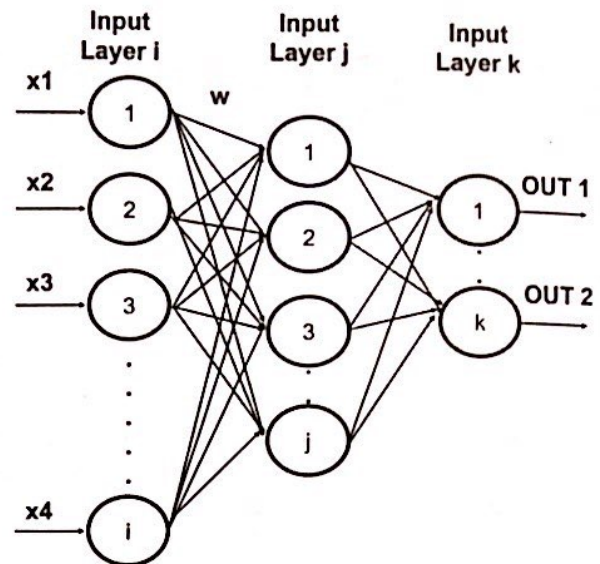
Fig. 6 Layered Artificial Neural Networks Used in Backpropagation Instruction K-Nearest Neighborhood

K-nearest neighborhood (K-NN) is considered as the good learning towards nonparametric and parametric segmentation and it is also very efficient when using with much teaching data. In this research, this appropriateness was use. Segmentation based on K-nearest neighborhood (K-NN) is considered as the good option. It is necessary for nearest neighborhood method to determine k parameter whereas k is the similar feature. There are 3 procedures of K-nearest neighborhood (K-NN) as follows:

Procedure 1: Choose K gene that is nearest to gene with Missing Values (MV) in order to estimate Missing Value X_{ij} of ith gene in the jth sample. Gene which is Expression Vector will be selected with expression more than that of sample.

Procedure 2: Calculate to find the distance between data of 2 Expression Vector X_i and X_j with Euclidian distance covering elements in the jth sample. Euclidian distance between X_i and X_j can be calculated by:

$$d(x_i, x_j) = \sqrt{\sum_{k=1}^{n}(x_{i,k} - x_{j,k})^2} \qquad (10)$$

Whereas,

$d(X_i, X_j)$ the distance between X_i sample and X_j sample.

N is the total properties of the sample.

$X_{i,k}$ is k property of X_i sample.

$X_{i,k}$ is k property of X_j sample.

Procedure 3: Select data value with the smallest amount of dist in k amount for considering and finding the answer.

- **Naïve Bayes**

$P(x|w_{face})$ and $P(x|w_{non\ face})$ is the class with pdfs condition of character and non-character, respectively. X Feature Vector is classified as the character format.

$$L(x) = \log\left(\rho(x|\omega_{face}) - \log(\rho(x|\omega_{nonface}))\right) \qquad (11)$$

In our guidelines, PDF file with format condition will be estimated by using Naïve Bayes Model that is treated to be operated well practically. This Naïve Bayes Model estimated the statistics of independence among elements of x Feature Vector. Under this hypothesis, we obtain:

$$\rho(x|\omega_{face}) = \prod_{i=1}^{N} \rho(x|\omega_{face})$$

$$\rho(x|\omega_{nonface}) = \prod_{i=1}^{N} \rho(x|\omega_{nonface}) \qquad (12)$$

$P(x|w_{face})$ and $P(x|w_{nonface})$ calculated by using histogram technique.

- **Bayesian Method**

In this article, we presented the measurement of similarity and probability based on the belief of Bayesian stated that differences of light intensity of images were presented by $\Delta = I_1 - I_2$ that was the characteristic of general

formats in the appearance of each person. Especially, we determined two types of face format: specific format Ω_I and special individual format Ω_E. Our similarity measurement was represented in the light of probability.

$$S(I_1, I_2) = P(\Delta\epsilon\Omega_I) = P(\Omega_I|\Delta) \qquad (13)$$

Whereas,

$P(\Omega_I|\Delta)$ is the following probability defined by Bayes Rule by using probability estimation $P(\Delta|\Omega_I)$ and $P(\Delta|\Omega_E)$. These probabilities were obtained from training data by specifying efficient empty space for data with high dimension.

- **Adaboost**

The first classifier of Adaboost segmentation is consisted of week classifier e.g., linear classifier, (each classifier classified only one data dimension of input vector. As a result, it is otherwise called week classifier. The results of segmentation are as follows:

$$H(x) = sign\left\{\sum_{t=1}^{T} \beta_t h_t(x)\right\} \qquad (14)$$

Whereas,

X represents Input Vector; $h_t)x(, t = 1, \ldots, T$, referring to the number of classification as T; $\beta_t, t = 1, \ldots, T$ refers to weight of each weak classifier.

- **Template Matching Techniques**

Template matching techniques are able to be used for finding the pixel level and the scope of script in template image. There are several template matching techniques that are used in image processing for finding the location of searched images. In this paper, cross relation template matching technique was used with the stimulation of distance measurement.

$$d_{f,t}^2(u, v) = \sum_{x,y}[f(x,y) - t(x-u, y-v)]^2 \qquad (15)$$

Whereas,

f is input image and it is the image of template matching.

- **Classification and Regression Tree (CART)**

CART was preferred by Breiman, Freidman, Olshen, & Stone in 1984. It is the method for rescurive partition creating classification and regression of trees for predicting continuously dependent variables (regression) and variables (classification). Generally, CART is able to be adjusted for two types of regression problems that was considered as the effort to predict continuous variables from continuous predictor or variables classification. The next problem was that classification of problems of variables depended on types of variables, for example, member group, etc., from one continuous variable or over.

Since these variables of classification were considered in this research, the research problems were classified as the problems of classification. The major objective of this analysis is to determine the condition set of logic classification that was permitted to be correct. There were 4 procedures of classification as follows:

Procedure 1: Specify criteria for accuracy of prediction;

Procedure 2: Select splits

Procedure 3: Determine the stop period of classification

Procedure 4: Select the tree with the "correct size"

IV. RESULTS

This research developed the program by using Matlab and 50 sample images of palm leaf manuscript's Isan Dhamma characters consisted of 550 characters and 120 digits therefore the total characters were 670. Table 1 represents the result on accuracy compared between SVM method and artificial neural networks.

Method	Accuracy Rate
Support vector machine	74%
Neural Network	86%
Decision Tree	65%
K-NN	70%
Naive Bayes	67%
Adaboost Cacade	60%
Bayesian	56%
Template Matching	72%

V. CONCLUSION

The proposed guidelines on palm leaf manuscript's Isan Dhamma characters segmentation and reading was started from image enhancement by using histogram and median filter. Subsequently, the obtained images were threshed by segmenting images in order to enable each image segment to use suitable threshold. In the following procedure, Principal Components Analysis (PCA) was used for finding the features of each sentence. Finally, obtained features were compared with database in order to find the range of such sentence by using neural network principles before comparing with support vector machine in order to compare such sentence with database. In addition, image vector was also replaced by image matrix in order to calculate and find intergroup distribution and internal distribution. Based on the experiment, it was found that this new method had the highest efficiency on calculation.

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HM King Rama IX and HRH Princess Maha Chakri Sirindhorn visited KMITL, and graciously granted Royal Permission to Prof. Srisakdi to be in the Audience.

HM King Rama X, when he was HRH the Crown Prince, graciously granted Royal Permission to Prof. Srisakdi to present an Honorary Ph.D. to HRH.

H.E. Prime Minister Prayuth Chan-Ocha, when he was the Army Commander, presented a token of appreciation to Prof. Srisakdi whom he invited to give a lecture on Cyber Warfare.

H.E. Prime Minister Prayuth Chan-Ocha, when he was the Army Commander, listened to Prof. Srisakdi's suggestion that he should stop the demonstrations by the red and yellow shirts.