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Advanced character based recognition and Phone handling for Blind peoples

R. Aarthi[1], N.R. Kruthika Devi[2], S. Prithi[3]

[1,2] *B.E/ ECE, Prince Shri Venkateshwara Padmavathy Engineering College*
[3]*Asst.Prof /ECE, Prince Shri Venkateshwara Padmavathy Engineering College*

Abstract*—Blindness makes life rather difficult for people who suffer from this health problem, but the use of technology can help them in day-to- day tasks. This paper describes an embedded device dedicated for blind or visually impaired people. Technology poses a challenge for blind people as well. For example, a blind person cannot read the information on a web page. Searching the internet requires screen reading software will read the information on a website, but this may require a significant amount of time to learn the process. In this context, the present work focuses the development of a text-to- speech application for the blind in both Tamil and English font. In this project raspberry pi as the main unit which has an USB camera that is used to scan any written document and uses Optical character recognition (OCR) to convert the image into a digital text. We then use a text to audio system that will enable us to convert the digital text into a synthesized voice. In this project, we develop a system in which the text written are been analyzed and Optical Character Recognition (OCR) is been performed. For feature extraction, Gabor filter algorithm is been proposed. To classify the input with the trained dataset, Support Vector Machine (SVM) is used. Additionally phone calls are established to the frequently contacted number just by their actions using gyroscope sensor. So it is an attempt to make the life of blind people quite independent.*

Key Words **- text detection, optical character recognition and speech synthesis, gyroscope sensor, GSM.**

I. INTRODUCTION

With increase in growing population, the number of blind people across the world is set to triple from about 36 million to 115 million by 2050. The uniqueness in characters were identified on physiological characteristics and behavioral characteristics. Uniqueness in signature, handwriting and voice comes under behavioral characteristics while face, iris, retina impression falls within physiological characteristics. We know that hand writing differs from person to person and even with respect to time which the person write. Hence a well-defined trained algorithm must be implemented to recognize the hand written documents. The efficiency of the system is 80-90% in order to recognize the slightly varied hand written documents. The document which has to be converted are captured as a image using USB camera connected with raspberry pi controller. Further the captured image are converted into binary image followed by line segmentation and word segmentation using horizontal and vertical profile components. For English font tesseract algorithm were inserted to identify the English characters and words up to 200 different types of fonts. And Tamil documents are recognized by separating number of horizontal, vertical and curved region present with in the character. A phone call is established through GSM just by detection their actions with gyroscope sensor so that it helps the blind people at emergency time. Were the detected actions were fed into ADC converter and the digital outputs were given to the GSM module. The process architecture describes the overall process involved in the device such as scanning, preprocessing, segmentation, feature extraction, classification and text detection as well as call establishment steps followed by description about the obtained results and conclusion.

II. PROCESS ARCHITECTURE

The recognition of both printed documents and hand written documents recognition involves in process such as Scanning, Preprocessing, Segmentation, Feature Extraction, self- organizing, Map classification and Recognition which is shown in the figure 1.And calls are established through GSM module by sensing the actions with gyroscope sensors.

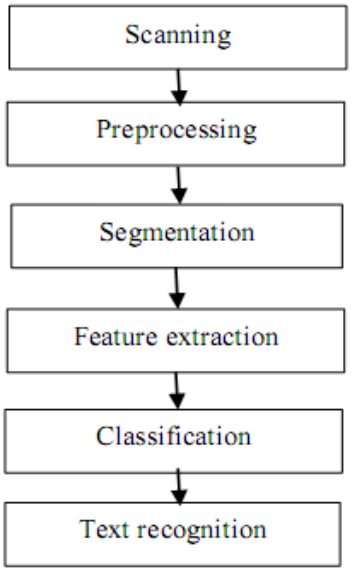

Figure 1: System Architecture

2.1 SCANNING

The documents are scanned using USB camera which is connected with one of the four ports of raspberry pi controller. The scanned documents are also viewed in personal computers. There would be a change in value of the pixels values at every steps of scanning which are termed as noise. The scanned images are stored in document is sent to a program that saves in TIF, JPG or GIF format.

2.2 PREPROCESSING

Preprocessing is the step involved after scanning process which consist of three steps namely, binarization, Noise removal and Skew correction. There are two peak values where high peak corresponds to the white background and a smaller peak corresponds to the foreground. The binarized image is preprocessed for noise removal which occurs due to the poor quality of the document or accumulated while scanning that has to be removed before further processing. The resultant image is checked for skewing. The image can either skewed with left or right orientation. The images are brightened, then angle of orientation between ±15 degrees are checked and if detected then image rotation is carried out until the lines match with the true horizontal axis, which produces a skew corrected image as given in figure 2.

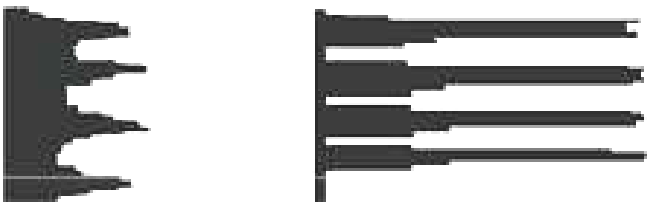

Fig. : 2 Histograms for skewed and skew corrected images

2.3 SEGMENTATION

The pre-processed image which is free from noise and skew corrected image is passed to the segmentation phase, where the image is decomposed into individual characters. Text lines can be identified with the help of the horizontal projection profile. Projection profile of a document in a particular direction is the running sum of the pixels along that direction. The profile exhibits valley points at line boundaries and the location of these minima points mark the line boundaries as shown in the figure 3. For binary images, these are the points where the profile goes to zero.

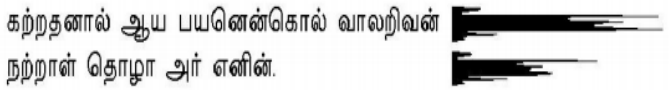

Fig. : 3 Line segmentation

Word segmentation can be performed with the aid of vertical projection profile. The vertical projection profile shows valleys at points corresponding to word gaps as shown in the figure 4. These word boundaries can be identified with the help of these minima points.

Fig. : 4 Word segmentation

The character segmentation are performed by detecting the pixels of the character and are segmented as shown in the figure 5.

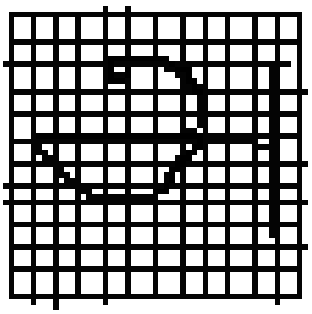

Fig. : 5 Character segmentation

2.4 FEATURE EXTRACTION

The next phase to segmentation is feature extraction where each character is represented as a feature vector, which becomes its identity. Feature extraction forms the backbone of the recognition process. The major goal of feature extraction is to extract a set of features, such as height, width of the character, number of short and long horizontal lines present, number of short and long vertical lines present, number of circles present, number of horizontally and vertically oriented arcs, centroid of the image and pixels in the various regions of the character which maximizes the recognition rate. Length of the character is computed by subtracting the column number of the last pixel to the column number of the first pixel. Height of the row is calculated by subtracting the row number of the last pixel to the row number of the first pixel. Area is the total number of pixels in the region. It is calculated by making the product of height and length. The shape of the character sometimes may be circular or curved forming a loop. Junction is the interface between two regions in the characters depending upon length and height of the pixels.

2.5 KOHONEN'S SELF ORGANIZING FEATURE MAP

The process of classification of documents was carried out in three phases. The first phase is document preprocessing. The second phase is the training process. The third phase is

the test phase in which a document is classified and the weights of neighboring units are updated.

Kohonen's SOFMs are a type of unsupervised learning. The goal is to discover some underlying structure of the data. With this approach an input vector is presented to the network and the output is compared with the target vector. If they differ, the weights of the network are altered slightly to reduce the error in the output. This is repeated many times and with many sets of vector pairs until the network gives the desired output. The network is created from a 2D lattice of 'nodes', each of which is fully connected to the input layer. Fig.2.5.1 shows a very small Kohonen's network of 4 X 4 nodes connected to the input layer representing a two dimensional vector. All neurons in the output layer are well connected to adjacent neurons by a neighborhood relation depicting the structure of the map. Generally the output layer can be arranged in rectangular or hexagonal lattice.

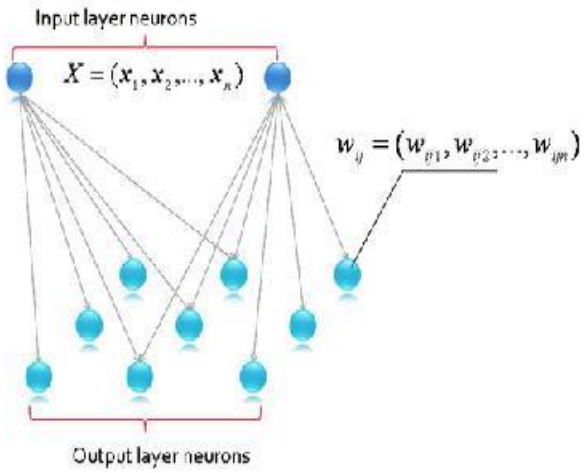

Fig. : 6 Kohonen's network of 4 X 4 nodes

Lots of activities in pre-processing stages helps to process this stage very easy. Self-organizing feature maps (SOFM) are unsupervised machine learning that learns by self-organizing and competition. The main idea for this is to make it simple and acceptable for Kohonen SOM. It reduces a remarkable amount of time. SOM is clustering the input vector by calculating neuron weight vector according to some measure (e.g. Euclidean distance), thus weight vector that closet to input vector comes out as winning neuron. However, instead of updating only the winning neuron, all neurons within a certain neighborhood of the winning neuron are updated using the Kohonen rule [20]. The algorithm is described as follows, suppose the training set has sample vectors X, trains the SOM network has following steps:

Step 1: Node's weights are initializing weights for each nodes.

Step 2: From the set of training data a vector is chosen at random and presented to the lattice.

Step 3: Every node is examined with the input node and whichever node most likely matches with the input vector is termed as the Best Matching Unit (BMU).

Step 4: The radius of the neighborhood of the BMU is now calculated whose value starts large, typically set to the 'radius' of the lattice but diminishes each time-step. Any nodes found within this radius are deemed to be inside the BMU's neighborhood.

Step 5: The neighboring node's weights are adjusted in such a way it's equal to the input vector. The node which is closer to the BMU has to alter its weight more.

Step 6: For N iterations repeat step 2.

i) Firstly, all neuron nodes weights, defined as W j (1), j = 1…L, are initialized randomly. L is the number of neurons in the output layer.

ii) K =Maximum (X,(k)), for iteration step k=1...K, get an input vector X(k) randomly or in order.

iii) Calculate Distance = X (k), k = 1…n, 1…n refers to neuron nodes.

iv) Select the winner output neuron j * with minimum distance.

v) Update weights Wj(k+1) to neurons j * and its neighborhood

W j (k+1) = Wj(k) + [(k+1) ∩ (j, j*(k+1),(k+1)][X(k+1) W j (k)], j=1…..L
vi)If k= K go to step (ii).

2.6 TEXT TO SPEECH

The scope of this module is initiated with the conclusion of the receding module of Character Recognition. The module performs the task of conversion of the transformed Tamil text to audible form. The Raspberry Pi has an on-board audio jack, the on-board audio is generated by a PWM output and is minimally filtered. A USB audio card can greatly improve the sound quality and volume. Two options of attaching a microphone into Raspberry Pi. One is to have USB mic, another to have an external USB sound card.

2.7 CALL HANDLING PROCESS

The actions from the blind people were detected with the help of gyroscope sensor with respect to changes in the XYZ axis direction. Hence the output of the gyroscope sensor is of analog form. In order to convert them into digital signal which is suitable for further computations we use ADC converter. The output digital signal from ADC block is then fed into Raspberry pi controller which sends them to the GSM module that has an inserted sim in its sim

slot. With respect to the python code the calls are established to the corresponding person. The analog signal are viewed in the pc.

III. SUPPORT VECTOR MACHINE

Supervised learning technique support vector machine is used for pattern classification. The binary classifier is built by standard SVM by constructing a hyper plane which separates to classes of data. The subset of informative points called support vectors are identified by SVM automatically which uses them to represent the separating hyper plane. With a set of training samples, (x_i,y_i) the machine are accessible where the x_i are the real world data instances and the y_i are the labels signifying which class the instance be appropriate to. When two class pattern recognition delinquent, $y_i = +1$ or $y_i = -1$. A training example (x_i,y_i) are called positive if $y_i = +1$ and negative otherwise. Hyper plane that separates two classes are constructed by SVM which tries to achieve all-out parting between the classes. Extrication the classes with a huge margin minimizes a bound on the expected generalization error.

IV. FINDINGS OF THE PROPOSED SYSTEM

To test the effect handwriting style has on character recognition with this system, samples from the five persons were scanned using USB camera. To test in an environment where 100% accuracy was obtainable, only the first 8 letters of each sample were used. This also reduced the amount of time and processing power needed to run the experiment. Each time in a slightly different position as shown in figure 7 and its accuracy where calculated. Letters from the sentence in the handwriting sample were used to create the test set to determine accuracy. Similarly English fonts were also implemented for handwritten English character recognition (ie for word) using Support vector machine.

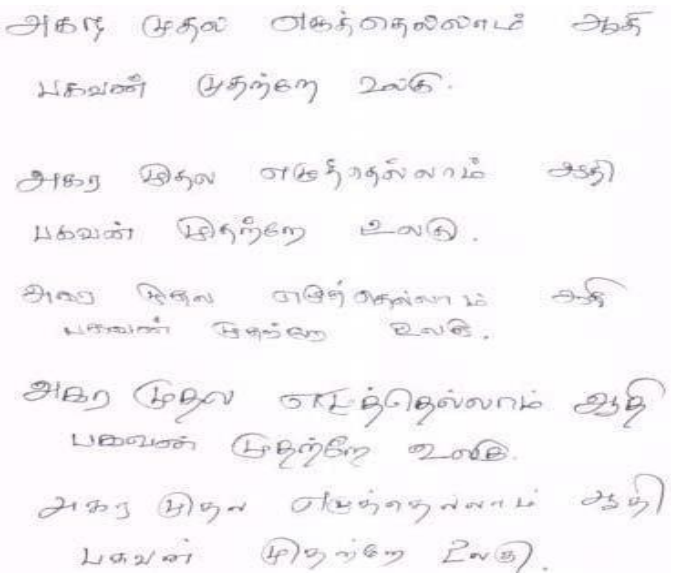

Figure: 7 Scanned handwriting

V. CONCLUSION

We investigated a new representation of Tamil Character Recognition, and used Kohonen SOM techniques efficiently classifies handwritten and also Printed Tamil characters. More effective and efficient feature detection techniques will make the system more powerful. There are still some more problems in recognition. They are, during letter segmentations and abnormally written characters. Misrecognition could be avoided by using a word dictionary to look-up for possible character composition. The presence of contextual knowledge will help to eliminate the ambiguity. We show that, in practice, the proposed approach produces near optimal results besides outperforming the other methodologies in existence. Our future work in this regard will be analyzing the features of joined letters and incorporating better segmentation accuracy. Results indicate that the approach can be used for character recognition in other Indic scripts as well. The call handling system helps the blind people to make out the calls easily without anyone's help. On the whole this system is used to establish the phone calls and recognize both English and Tamil font with different size and hand written documents too.

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