

Visual Recognition of Bengali Sign Language using Local Binary Pattern Compared with ANN

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Abstract

This paper presents an overview of visual recognition of Bengali Sign Language. In this paper we learn and detect a sequence of sign words and recognize the sign language that are understandable to the deaf and hearing impaired people to help normal people understand the meaning of these words. The research discusses the characteristics of the human sign languages, the requirements and difficulties behind visual sign recognition, how to deal with others persons and the different techniques used in the sign language recognition. The paper consists of two major parts, namely the learning part and the detection part. The system takes the sign images as its input. First sign images are learnt by the proposed system. When a sign image is given for recognition, the detection part identifies the image with the help of previously learned images. For learning and detection we have used local binary pattern compared with back propagation algorithm of Artificial Neural Network. We believe that this research will be of much help to express their thoughts and feelings between the deaf people and the normal people.

Index terms— sign language, ANN, back propagation algorithm, local binary pattern.

1 Introduction

any people are hearing impaired in our country. Sign languages are used by the hearing impaired people to mainly communicate with other peoples of their kind, and also to some extent with their friends, families as well. Many of these people are intelligent enough to share their opinions and work with rest of the population to move ahead our country. They participate in different development organizations in different sectors. But there is a communication gap between the hearings impaired and/or deaf people and the rest of the people in our country. They can communicate with their family members as they also learn sign language to some extent in the process of observing and interacting with the disabled person in the family day after day. They can communicate with other people who know sign language. But, it is difficult for normal people to communicate with them when hearing impaired and/or deaf people work with normal people in different organization and/or development sectors. The communication between the hearing impaired people and the normal people are not well defined. It is important to communicate with hearing impaired and deaf people in an understandable way to share their opinions, to solve their problem and help them to be a part our normal day to day life. In this paper we work on the Bengali Sign Language that helps both the hearing impaired & deaf people and the normal people to express their thoughts and feelings and to give them a better medium for communication and exchanges of ideas [2]. This paper follows the Bengali Sign Language dictionary to create the understandable sentences using the easy words. First, we will learn the images of these words sign language and store it. Then we can take as input a sign language image and compare it with our stored sign language words to recognize what the input image represents in sign language. This paper has been done to make the people to recognize the sign language with an easy way and also to communicate with others.

2 II.

3 Sign Language

A sign language (also signed language) is a language which, instead of acoustically conveyed sound patterns, uses visually transmitted sign patterns (manual communication, body language and lip patterns) to convey meaning-simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions to fluidly express a speaker's thoughts. Sign languages commonly develop in deaf communities, which can include interpreters, friends and families of deaf people as well as people who are deaf or hard of hearing themselves [4]. In Bangladesh the method of teaching the hearing impaired and/or deaf children started more than three decades ago. Lip reading, use of sign language and speech training has been followed in teaching them. Though the basis of sign language is the same, yet every country has developed its own techniques according to its own language. Teachers who are working in this particular fields are trained in different countries where the follow their own methods and techniques, specially the sign language. So it is not expected that all of them will follow the signs. More over the hearing impaired children of the different parts of the country use their own sign language according to their needs and local conditions, but no step was undertaken for the hearing impaired in Bangladesh [2]. Considering all these facts and prevailing conditions of this particular field, steps have been taken by the Department of Social Services to develop a uniform sign language dictionary In this recognition system, sentences of the form personal pronoun, verb, adjective, personal Pronoun" are to be recognized. This sentences such as I eat rice (Avwg fvZ LvB) structure emphasis the need for a distinct grammar for Bengali Sign Language recognition and allows a large variety of meaningful sentences to be randomly generated using words from each class. Table 1 shows the words chosen for each class [3]. At first a naive eye was used to avoid ambiguities in the selected signs, but this was shortly subsumed by the Table1.

4 III. Sign Languages' Relationships with Oral Language

A common misconception is that sign languages are somehow dependent on oral languages, that is, that they are oral language spelled out in gesture, or that they were invented by hearing people. Hearing teachers in deaf schools, such as Thomas Hopkins Gallaudet, are often incorrectly referred to as "inventors" of sign language. Manual alphabets (finger spelling) are used in sign languages, mostly for proper names and technical or specialized vocabulary borrowed from spoken languages. The use of finger spelling was once taken as evidence that sign languages were simplified versions of oral languages, but in fact it is merely one tool among many. Finger spelling can sometimes be a source of new signs, which are called lexicalized signs. On the whole, deaf sign languages are independent of oral languages and follow their own paths of development. For example, British Sign Language and American Sign Language are quite different and mutually unintelligible, even though the hearing people of Britain and America share the same oral language. Similarly, countries which use a single oral language throughout may have two or more sign languages; whereas an area that contains more than one oral language might use only one sign language. South Africa, which has 11 official oral languages and a similar number of other widely used oral languages, is a good example of this. It has only one sign language with two variants due to its history of having two major educational institutions for the deaf which have served different geographic areas of the country [5].

5 IV. Basic Concept of Neural Network

In general neural network are simply mathematical techniques designed to accomplish a variety of task. Neural networks can be configured in various arrangements to perform a range of tasks including pattern recognition, data mining, classification and process modeling. The later is the primary interest in this context and although the types and topologies of neural networks vary greatly in the field, by far the most commonly used type of neural network, particularly in process control, is feed-forward, back-propagation neural network [6]. Our basic computational element model neuron is often called a node or unit. It receives input from some other units, or perhaps from an external source. Each input has an associated weight w , which can be modified so to model synaptic learning. The unit computes some function f of weighted sum of its inputs: Its output, in turn, can serve as input to other units. The architecture of the 3-layer neural network besides processing an input and an output layer also has an intermediary layers called hidden layer. The computational units of the hidden layer aids in performing useful intermediary computation before directing to the input to the output layer. The input layer neurons are linked to the hidden layer neuron and the weight on these links is referred to as input hidden layer weight. The hidden layer neurons are linked to the output layer neurons and weights. On these links are referred to as hidden-output layer weights. A model of multilayer network also called three-layer is shown below:

6 Priciples of Local Binary Patterns

The original LBP operator was introduced by Ojala et al. [9]. This operator works with the eight neighbors of a pixel, using the value of this center pixel as a threshold. If a neighbor pixel has a higher gray value than the center pixel (or the the same gray value) than a one is assigned to that pixel, else it gets a zero. The LBP code for the center pixel is then produced by concatenating the eight ones or zeros to a binary code (figure ??3).

If the gray value of the center pixel is g_c and the gray values of his neighbors are g_p , with $p = 0, \dots, p-1$, than the texture T in the local neighborhood of pixel (x_c, y_c) can be defined as: $T = t(g_c, g_0, \dots, g_{P-1})$

Once these values of the points are obtained is it also possible do describe the texture in another way. This is done by subtracting the value of the center pixel from the values of the points on the circle. On this way the local texture is represented as a joint distribution of the value of the center pixel and the differences: $T = t(g_c, g_0 - g_c, \dots, g_{P-1} - g_c)$ (4)

Since $t(g_c)$ describes the overall luminance of an image, which is unrelated to the local image texture, it does not provide useful information for texture analysis. Therefore, much of the information about the textural characteristics in the original joint distribution (Eq. 3) is preserved in the joint difference distribution (Ojala et al. 2001): $T(g_0 - g_c, \dots, g_{P-1} - g_c)$ (5)

Although invariant against gray scale shifts, the differences are affected by scaling. To achieve invariance with respect to any monotonic transformation of the gray scale, only the signs of the differences are considered. This means that in the case a point on the circle has a higher gray value than the center pixel (or Visual Recognition of Bengali Sign Language using Local Binary Pattern Compared with ANN Later the LBP operator was extended to use neighborhoods of different sizes. In this case a circle is made with radius R from the center pixel. P sampling points on the edge of this circle are taken and compared with the value of the center pixel. To get the values of all sampling points in the neighborhood for any radius and any number of pixels, (bilinear) interpolation is necessary. For neighborhoods the notation (P, R) is used. In the last step to produce the LBP for pixel (x_c, y_c) a binomial weight 2^p is assigned to each sign These binomial weights are summed: $\sum_{p=0}^{P-1} (s_p - s_c) 2^p$ (7)

The Local Binary Pattern characterizes the local image texture around (x_c, y_c) . The original LBP operator in figure ??3 is very similar to this operator with $P = 8$ and $R = 1$, thus LBP8,1. The main difference between these operators is that in LBP 8,1 the pixels first need to be interpolated to get the values of the points on the circle.

7 VI. Sign Recognition using Local Binary Pattern Compared with Back Propagation Algorithm

The benefit of the middle-hidden layer allows ANN to develop its own internal representation of this mapping. Such a rich and complex internal representation capability allows the hierarchical network to learn any mapping and not just linearly separable ones. Let us consider the three-layer network with input layer having 'l' nodes, hidden layer having 'm' nodes and an output layer with 'n' nodes. We consider sigmoidal functions for activation functions for the hidden and output layers and linear activation function for input layer [7]. The number of neurons in the hidden layer may choose to lie between 1 and 21. The basic algorithm loop structure is given as Initialize the weights Repeat For each training pattern Train on that pattern End Until the error is acceptably low While To implement the sign recognition in this research works, we proposed the Local Binary patterns methodology. Local Binary Pattern works on local features that uses LBP operator which summarizes the local special structure of a face image [11].

LBP is defined as an orders set of binary comparisons of pixels intensities between the center pixels and its eight surrounding pixels. Local Binary Pattern do this comparison by applying the following formula: $s = \sum_{p=0}^{P-1} (s_p - s_c) 2^p$ (15)

Where s_c corresponds to the value of the center pixel (x_c, y_c) , s_p to the value of eight surrounding pixels.

8 Results and Discussion

Bengali Sign Language recognition is not a simple problem since a new image of a sign seen in the recognition phase is usually different from the image seen by the learning phase. Although a sign image has unique features for sign language recognition there are several sign uses by the human. The sign image depends on viewing conditions and environment. In addition the sign image changes according to the expressions. Bengali Sign Language recognition Visual Recognition of Bengali Sign Language using Local Binary Pattern Compared with ANN also works by using basic LBP operator. Feature extracted matrix originally of size 3×3 , the values are compared by the value of the centre pixel, then binary pattern code is produced and also LBP code is obtained by converting the binary code into decimal one. research, which is flexible and efficient, should be able to solve the problems. This section reveals results obtained by the image detector that has been developed. In this paper the detector has been tested on images that contain sign image and every image The following table shows overall sign words learning and detection rate:

It is expected from sign language recognition system to acquire high accurate recognition rate while detection rate should be too low. In the table-II, the detection rate is 99%. While the detection rate using the back propagation algorithm is 93%. We detect the sign word one after another and recognize the sign language. From the experimental result, it is seen that the research satisfies all requirements to recognize the sign language.

9 a) Conclusion

In this study, we presented an off-line Bengali Sign Language recognition research which is based on Local Binary Pattern compared with artificial neural network using Back propagation algorithm. The purpose of this research is to implement Bengali Sign Language recognition. Through use of LBP algorithm low error rates were achieved on both learning an image and testing image. The accuracy of the system is 99% by using LBP algorithm.

It is obvious that the result of this Bengali Sign recognition system but due to some limitation we were not able to implement all portion of the research yet. The main improvements will pursue the performances, recognize of multiple images. What is more the following are few points that we are going to address the near future [8].

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Figure 1: MF

পদ প্রকার (Parts of Speech)	শব্দ তালিকা (Words List)
সর্বনাম (Pronoun)	আমি/আমার (I/My), তুমি (You), আমরা/আমাদের (Our), তারা/তাদের (They) etc.
ক্রিয়া (Verb)	খাওয়া (Eat), খেলা করা (Play), ঘুমানো (Sleep), যাওয়া (Go), পড়া (Read), জানা (Know) etc.
বিশেষ্য (Noun)	বই (Book), টেবিল (Table), স্কুল (School), ভাত (Rice), পছন্দ করা (Like) etc.
বিশেষণ (Adjectives)	লাল (Red), নীল (Blue), সাদা (White), হলুদ (Yellow) etc.

Figure 2: Figure1:

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$$y_i = f(\sum_j w_{ij} y_j)$$

Figure 3: Figure 2 :

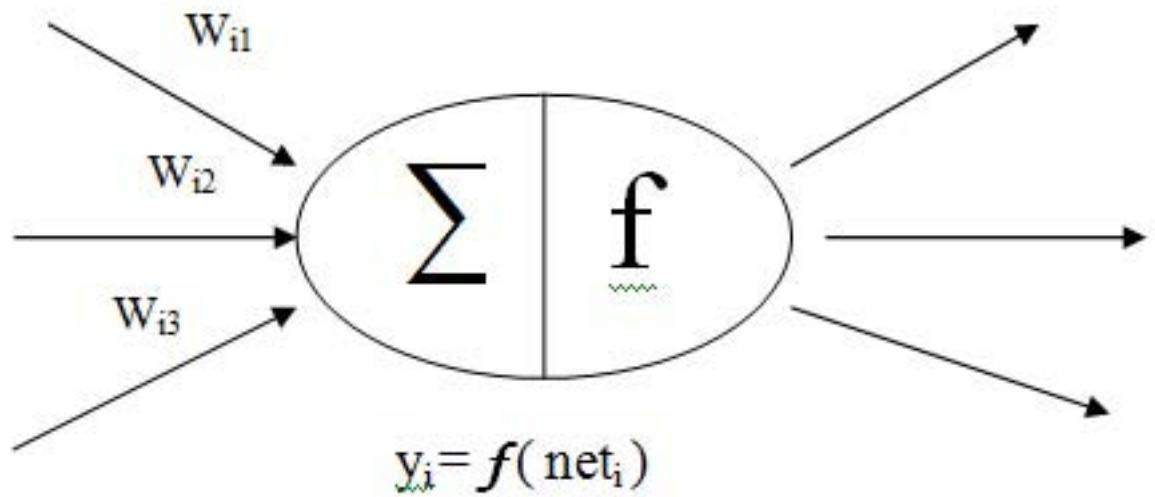


Figure 4: Figure 3 :

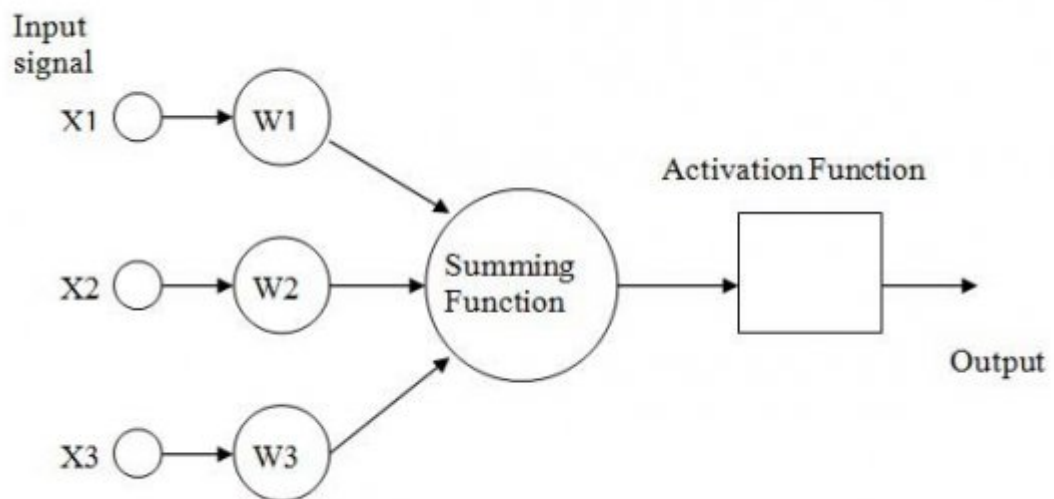


Figure 5: Figure 1 . 3 :Figure 1 . 4 :

Figure 6:

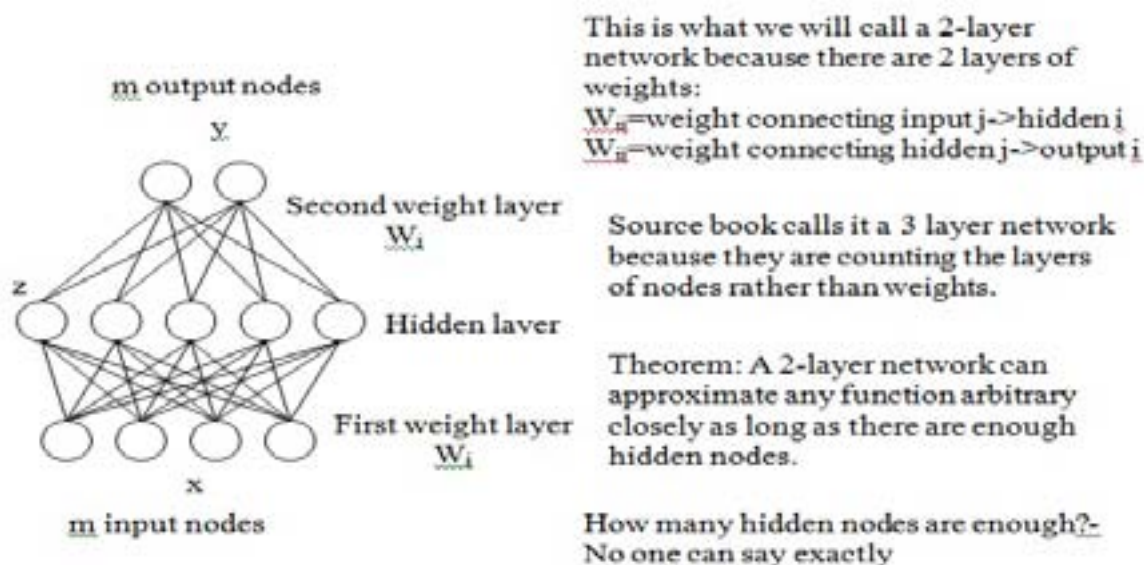


Figure 7:

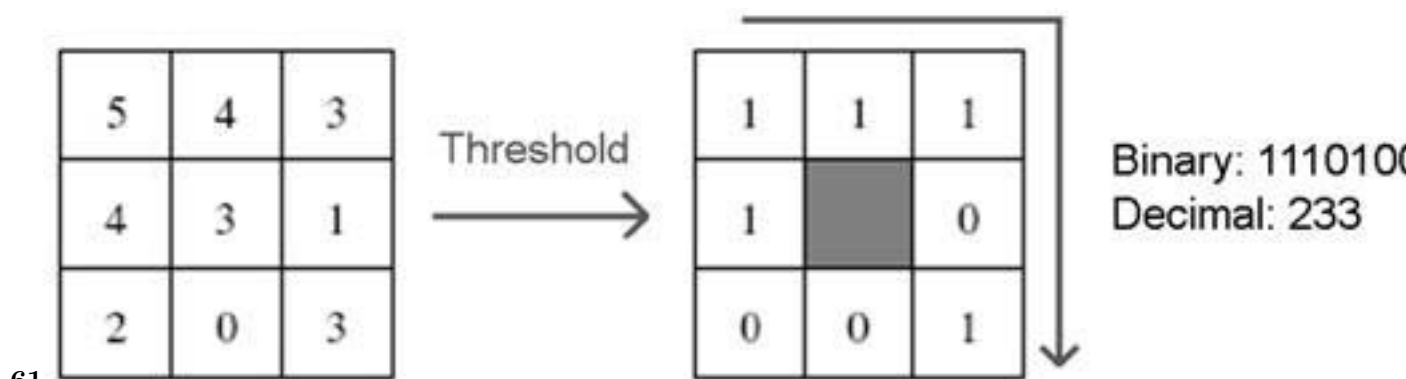


Figure 8: Figure 6 . 1 :

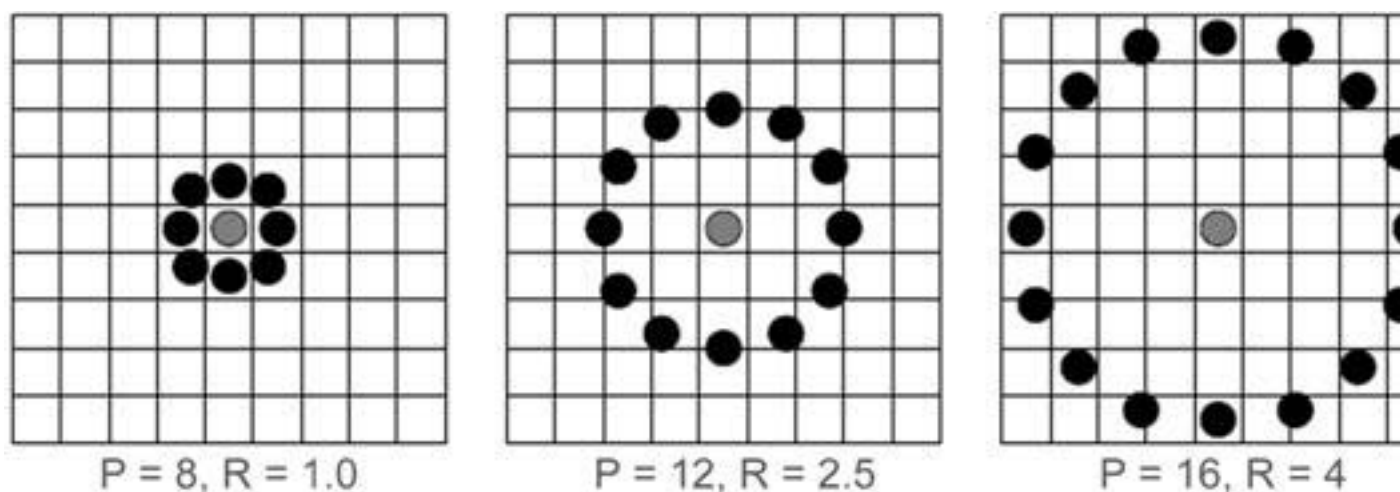


Figure 9: GlobalF

4

Figure 10: Figure 4 :

5

$$s(x) = \begin{cases} 1, & x \geq 0 \\ 0, & x < 0 \end{cases}$$

Figure 11: Figure 5 :

1

Figure 12: Table 1 :

2

Figure 13: Table 2 :

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