Design and Development of Sign Language Communication Gadget via Structural Redesigning of Artificial Intelligence Technique

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Abstract: The significance intention of this research work is to develop a system for predicting static gestures of alphabets and sign in Indian Sign Language (ISL) to text. This proposed model incorporates three section pre-processing, feature extraction and structural redesigning. The novelty of this work lies in structural redesigning done with conventional Artificial Neural Network (ANN) to improve its prediction accuracy. The structural redesign happens with the aid of optimization techniques to precise its predicting accuracy. The preliminary research carried out with benchmark dataset to design and validate the redesigned optimal neural network structure by influencing Genetic Algorithm (GA), Particle Swarm Optimization (PSO) and Artificial Bee Colony (ABC). Amid, ABC prefers superior result to other comparative algorithms and reveals the predictive accuracy of 96.71%. Subsequently, ISL gestures collected from real time environment to perform the objective by influencing Social Spider optimization (SSO) technique. The revealed results illustrate that SSO having superiority to ABC (which prefers better result in preliminary benchmark dataset). In real world environment the proposed SSO technique, reveal average of 83.9% this will be a superior result over other comparative technique. The entire implementation execute in the working platform MATLAB to process the ISL to text prediction.

Keyword: Indian Sign Language (ISL), Artificial Neural Network (ANN), Social Spider optimization (SSO), Artificial Bee Colony (ABC) and gesture recognition to text.

I. INTRODUCTION

Language is the prime methods of communication of individuals. Sign is the most experienced method for communication of the primitive man when there is no appropriate language. These days the sign language is likewise favored among the deaf-dumb people. [1] Deaf individuals make real issues when sharing their feelings the all inclusive community who can't grasp their Sign Languages. [2] Sign language is the composed movement that is used by the tuning in to debilitated group to pass on. Tuning in to people use verbal communication, while sign language is a kind of visual communication. [3] However, a champion among the most provoke issues of the Sign Languages is that not a lot of people outside the hard of a hearing aide amass are truly prepared to talk them.[4] The gesture based communication is the major specific system between people who encounter the ill impacts of tuning in to imperfections. Sign language is a collection of gestures, movements, postures, and facial expressions contrasting with letters and words in like manner languages.[5] The fundamental research identified with sign language recognition expresses that there is a need of brilliant progress in this domain.[6]

Sign language is a computer vision based language for deaf and hearing people, which incorporates using hands, face and body.[7] Each country uses their own particular local language according to sign language is stressed over their own linguistic and syntactic significance. Like British Sign Language (BSL) and American Sign Language (ASL), the language which is being used as a piece of India is called Indian Sign Language in the future ISL. [8] ISL uses both single hand and twofold hands to make signs to address by far most of the alphabets, ISL uses both static and dynamic sort hand gestures. [9] In these, showing of the hand image was performed to separate the hand postures by considering physiological confinements of hand viz., finger joint improvements with high level of chance, joint point limits, advancement sorts, flexion and adduction/abduction of metacarpophalangeal (MP) joints. [10] We have proposed a system, which can see the different alphabets of Indian Sign Language for Human-Computer participation giving more exact results in any occasion possible time.[11]

II. LITERATURE REVIEW

Sirshendu Hore *et al.* [12] 2017, had proposed an exact sign language recognition framework can energize more correct correspondence of deaf and dumb individuals. The wide variety of Indian Sign Language (ISL) incited also troublesome learning process. The proposed systems execution was contrasted from NN and the Multilayer Perceptron Feed-Forward Network (MLP-FFN) classifiers. The test occurs set up that the proposed algorithm achieved broad change over the execution of existing works with a particular true objective to perceive ISL gestures. The NN-PSO beat substitute strategies with 99.96 accuracy, 99.98 precision, 98.29 recall, 99.63 F-Measure and 0.9956 Kappa Statistic.

Zafar Ahmed Ansari *et al.* [13] 2016, had suggested that individuals with talk handicaps pass on in sign language and thus experience difficulty in mixing with the proficient. A practical inconspicuous Indian sign language recognition framework

was executed and attempted on certifiable data. In the finger spelling classification of our dataset, fulfilled more than 90% recognition rates for 13 signs and 100% recognition for 3 signs with general 16 unmistakable letters all together (A, B, D, E, F, G, H, K, P, R, T, U, W, X, Y, Z) recognition with a normal accuracy rate of 90.68%.

Siddhartha Pratim Das *et al.* [14] 2015, had anticipated a vision-based way to deal with group facial gestures (lip movement, eye brow pattern and so forth.) for communication composed particularly for the contrastingly abled people was a less investigated zone. In this work, composed a continuous framework to identify alphabets by recognizing the lip design based on texture and shape. The framework takes live video input and procedures it continuously. The recognizer planned utilizing Artificial Neural Network (ANN) to perceive four classes viz. the lips developments framed for the four alphabets A, B, C, D. The whole framework demonstrated and tried for real time execution with a video of 10 frames per second. Trial comes about demonstrate that the framework gives agreeable execution with recognition rate as high as 90.67%.

Kumud Tripathi *et al.* [15] 2015, had proposed a continuous Indian Sign Language (ISL) gesture recognition framework where both the hands are utilized for performing any gesture. Recognizing a sign language gestures from continuous gestures was an extremely difficult research issue. Analyses are performed without anyone else nonstop ISL dataset which is made utilizing standard EOS camera in Robotics and Artificial Intelligence laboratory (IIIT-A). Probes are tested utilizing different sorts of classifiers like Euclidean distance, Correlation, Manhattan distance, city block distance and so forth. Similar examination of our proposed plot was performed with different sorts of distance classifiers. From this examination, found that the outcomes got from Correlation and Euclidean distance gives better accuracy then different classifiers.

III. PROPOSED METHODOLOGY

In the section the methodology derived in two cases, let us discuss one by one in detail.

3.1 Case-I,

The preliminary research work is to utilize conventional ANN incorporate with nine different training algorithms, then finding best training algorithm suit this dataset. The imply training techniques in conventional ANN are listed as follows Levenberg-Marquardt (lm), Bayesian regularization (br), Scaled conjugate gradient (scg), Resilient (rp), BFGS quasi-Newton (bfg), Conjugate gradient (cgb), Conjugate gradient (cgf), One-step secant (oss)and Gradient descent (gd). Amid, lm reveals 75% predicting accuracy; which is superior to other comparative techniques. So, consider lm as a training technique and then took the intention of redesigning its default structure. To accomplish this redesigning conventional ANN structure incorporation of optimization techniques take place to compute the process more reliable. Optimization techniques utilize to redesign the ANN structure are Genetic Algorithm (GA), Particle swarm Optimization (PSO) and Artificial Bee Colony (ABC).
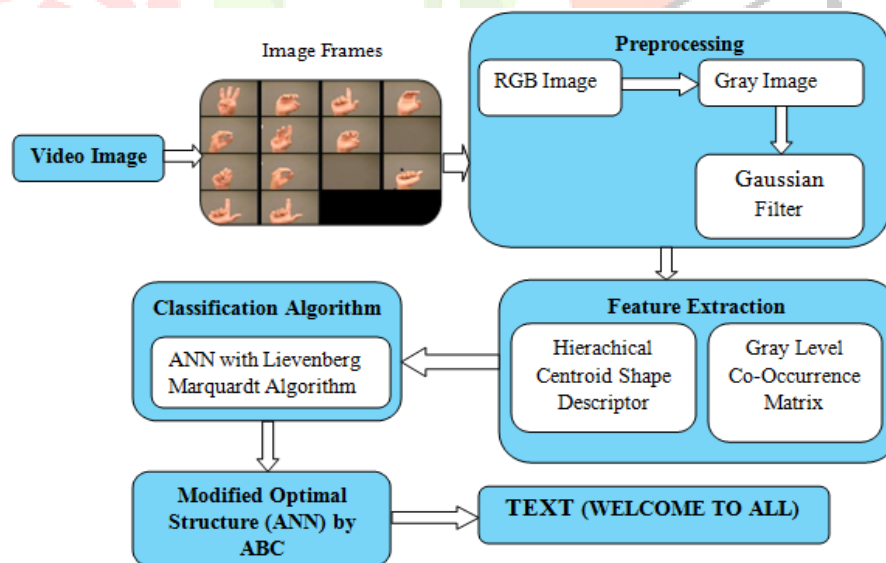

Fig.1 Overall flow of proposed system

3.1.1 Video to Frame Conversion

To perform the work further video cannot directly utilize for the purpose of classifying and predicting the text based on given ISL video file. To retrieve accurate predicting rate pre-processing and feature extraction place a significant role.

3.1.2   Pre-Processing

Initially, the segregated frames (images) from the video is in the form of RGB is converted to gray image for couple of significance reason simplicity and data reduction. RGB having 3D matrix it is hard to compute and occupy space whereas in gray scale the average of RGB is collectively consider gray scale, it will certainly reduce the complexity in computing and occupy 1/3 space in RGB. Then, these converter gray images applied for filtering process; here Gaussian filter applied to remove noise and keep edge relatively sharp in the fed input images.

3.1.3   Feature Extraction

Hierarchical Centroid Shape Descriptor (HCSD) technique based on kd-tree technique decomposition, it draw centroid coordinate from binary image. The descriptor gets an image and computes the x-coordinate of the centre of mass. Then, the descriptor subdivides the image into two images by the x-coordinate and calls itself (recursively) on the transpose of each of the two sub-images. The coordinate values calculated relative to the complete image and returned. In order to balance the representation the descriptor also computed on the transposed image and the two resulting vectors are concatenated. The attained 128 features extracted from HCSD further utilized in classifier. Along with this HCSD, Gray-Level Co-Occurrence Matrix (GLCM) extracts seven additional features for betterment in predicting text. Those added features are auto correlation, cluster shade, dissimilarity, Energy, Entropy, Homogeneity, Maximum probability.

3.1.4   Classifier Utilize for Predicting Given ISL Image

Here, we utilize Artificial Neural Network (ANN) for predicting ISL image in to text format; initially we utilize default ANN comprised of single hidden layer having ten neurons in it. Nine different training algorithms involve in this process namely Levenberg-Marquardt back propagation, Bayesian regularization back propagation, Scaled conjugate gradient back propagation, Resilient back propagation, BFGS quasi-Newton back propagation, Conjugate gradient back propagation with Powell-Beale restarts, Conjugate gradient back propagation with Fletcher-Reeves updates, One-step secant back propagation and Gradient descent back propagation. Amid, Levenberg-Marquardt back propagation behave literally well in training section for predicting ISL image to text.

3.1.5   Redesigning the Conventional ANN Structure

The intention for redesigning the ANN structure is to extract the optimal potential of artificial intelligence technique, as we all know that ANN work under the principle of well derived sigmoid function. The conventional working structure clearly state that the input travel via neuron carrying weights then manipulate with active and bias function before revealing the process output. This paves the vision towards changing the objective function (Hidden layers-neurons) of ANN with the aid of optimization techniques. Here, we had tested three different optimization techniques so far; amid, Artificial Bee Colony (ABC) technique behaves literally well and fix appropriately in this Hidden layer and neurons optimization problem.

IV. RESULTS AND INVESTIGATIONS

4.1 Case-I

This section discuss various analysis with attain results from different techniques, initially with 2770 ISL dataset 80% utilize for training and 20% utilize for testing. We apply nine different training algorithms in the conventional network structure having single hidden layer having 10 neurons in it. In that analysis levenberg marquardt (lm), prove its superiority compare with all training algorithms, then by fixing lm as a training algorithm, we further redesign the conventional structure. This redesigning process incorporates three different optimization techniques namely GA, PSO and ABC amid, ABC prove its superiority in this whole analysis. Let us discuss one by one analysis with different optimization techniques in detail.

4.4.1   Evaluating accuracy for different optimization techniques in validation

This process incorporates the evaluation of optimization techniques in redesigned structure ANN and conventional structure in ANN, in this analysis it is clear that the proposed ABC reveals superior accuracy than other competitive techniques.
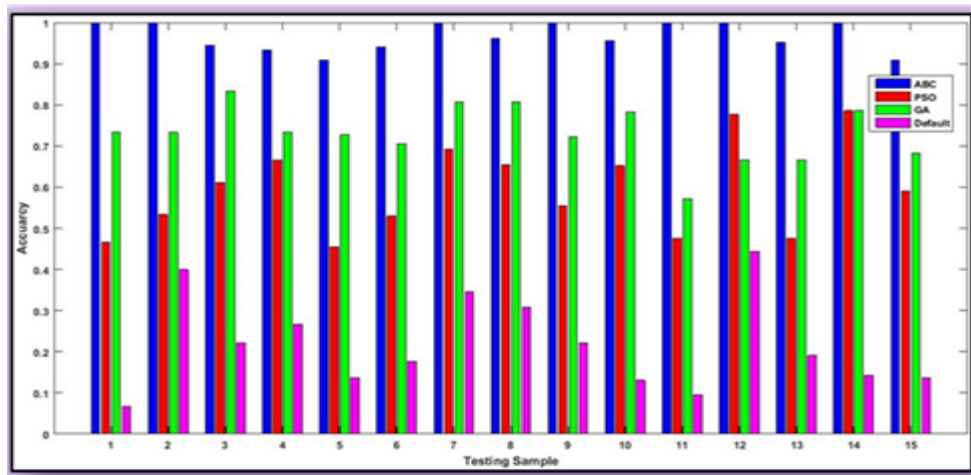
Fig.2 Validation with different techniques

Here, proposed ABC technique leads the competition with huge margin compare with other techniques. Especially compare with conventional ANN designing structure the proposed technique ABC incorporate in designing far better in its accuracy. In over all in this analysis the proposed ABC technique reveals/ predicts almost 96.71% accurately, where as PSO, GA and default/conventional techniques having accuracy rate of 59.48%, 73.05 and 21.89% respectively. This accuracy based revealed output for individual techniques clearly showed in table-1.

TABLE.1: COMPARING CONTEMPORARY AND CONVENTIONAL (TECHNIQUES)

Video Frames	Actual String	ABC	PSO	GA	Default (lm) [17]
	'I CAN THINK OUT OF BOX'	'I CAN THMNK OUT OF BOW'	'K CAO TGLOQ PTT PK BPZ'	'H CAM TGMMK OTT OF BOX'	'AFCDIFTLKI FQWTFQBFA Q '
	'I LOVE MY COUNTRY'	'I LOVE MX COUNTRY'	'K LPVE LW CPTOTTY'	'H IOVE MV COTMTRY'	'AFSQVEFK FCQWIRLV'
	'I WANT TO BECOME SCIENTIST'	'I WANT TO BECOME SCIENTIST'	'K WAOT TP BECPLE SCKEOTKST'	'H WAMT TO BECOME SCHEMTHST'	'AFYDITFTQF AECQKEFOC AEITAOT'
	'I WANT TO SERVE MY SOCIETY'	'I WANT TO SERVE MX SOCIETY'	'K WAOT TP SESVE LW SPCKETV'	'H WAMT TO SERVE MV SOCHETT'	'AFYDITFTQF OEKVEFK FOQCAETM'
	'KNOWLEDGE IS POWER'	'KNOWLEDGE IS POWER'	'OOPWMEDGE KS RPWES'	'RMOWKEDKE HS POWER'	'UIQYMEEGE FAOFLQYES'
	'MY NAME IS VENKATASWA MI'	'MX NAME IS VENKATASW AMI'	'LW OAME KS VEOQATASWAL K'	'MV MAME HS VEMKATASWA MH'	'K FIDOEFAOFW EI DTDOYDKA'

	Actual String			
	'NOTHING IS IMPOSSIBLE'	'NOTHING IS IMPOSSIBLE'	'OPTHLNH KS KLRPSSHBJE'	'MOTGJMH HS HMPOSSIBKD'	'IQRHCNDFA OFAKLQPPH ARI'
	'YOU ARE MY INSPIRATION'	'XOU ARE MX INSPIRATION'	'WPU ASE LW LNSPHSATIPN'	'VOU ARD MV HMSQIRATIOM'	' PZFDPIFK FANPKHKAR BQN'

4.2 Case-II

This section carried out with real time investigation, this analysis incorporates couple of optimization methodology ABC and SSO. Amid, SSO reveal superior accuracy over ABC as shown in table 2.

TABLE.2. COMPARING CONTEMPORARY WITH ABC AND SSO

Video Frames	Actual String	ABC	SSO
	HAVE A NICE DAY	HEVE A NICE DAY	HAVE A MICE DAY
	I AM IN COLLEGE	IDAM UN CDLLHGE	I AN IN COLAEGE
	I AM VERY HAPPY	I AM VTRG HAPLH	I AM VETY HDPPT
	I LOVE MY COUNTRY	I LRVE MY CKNTURF	I LOVD MT COUNGRW
	MY NAME IS ANITA	MYHNDME IS ANTRA	MY HAME IS AVIGA
	THANKS FOR HELPING	THFNLD FOR HRLYING	THDNKS FER HELYIFG

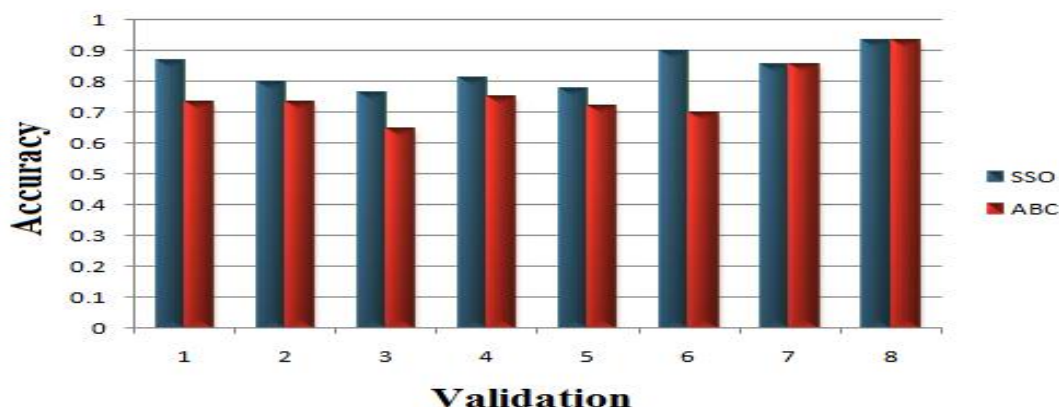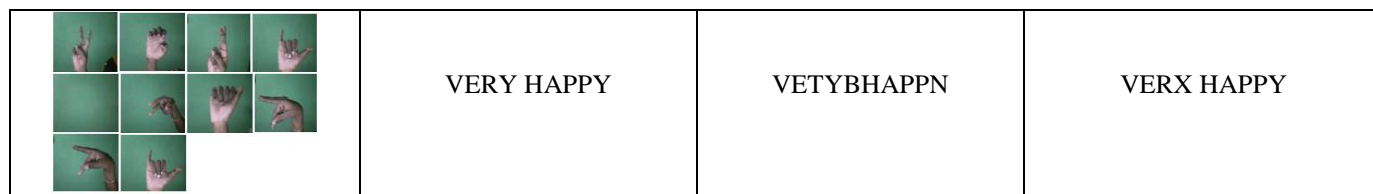|	VERY HAPPY	VETYBHAPPN	VERX HAPPY

Figure .3 Comparison graph

From the above illustration it is quite evident the proposed SSO having superior accuracy value over ABC. The average accuracy value for SSO in aforementioned validation is 83.9% and ABC having 75.9%, the proposed SSO having 9.53% greater impact over comparative technique.

V. CONCLUSION

The significance intention clearly executed in this research work by considering conventional ANN structural design and then redesign by incorporating optimization techniques as preliminary work. This work shows the evident result over conventional techniques with predicting accuracy of 96.71%. Efficient redesigned neural network utilize further for real world testing to recognize ISL to text. Here, SSO influence to enhance predicting accuracy over preliminary proved ABC technique; but in this real world testing SSO try to achieve 83.9% and preciously proved ABC achieve 75.9%. In future, incorporation of more number of dataset for testing and further more newly develop optimization technique will enhance the performance of predicting system.

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