Real Time Indian Sign Language Gesture Recognition as Text with the Aid of Redesigned Artificial Neural Network

[1]Anita S.Walde , [2] Dr.Ulhas D. Shiurkar
[1]Research Scholar, DIEMS Aurangabad , [2]Director DIEMS Aurangabad.
Department of Electronics and Telecommunication
[1]Deogiri Institute of Engineering and Management Studies, Aurangabad, M.S, India.

Abstract : Gesture to text mode of communication is a boon for physically ear-impaired people, this state of communication strengthen the context of preliminary hearing impaired -mute people. This paper handles real time Indian Sign Language (ISL) gesture to be predicting as an appropriate text with the aid of artificial intelligent associate with soft computing techniques. Here, a redesigned Artificial Neural Network (ANN) utilizes to predict gesture as text by incorporating couple of swarm intelligence techniques Artificial Bee Colony (ABC) and Social Spider Optimization (SSO). The role of aforementioned optimization techniques is to predict the optimal structure (Number of hidden layers and neurons associate) for ANN execute in this context. Both swarm intelligence technique execute almost fine with SSO take marginal superiority. In average, ABC having 75% accuracy on other hand SSO holds 83% accuracy, which is 8% lead over contest methodology.

Index Terms **- Indian Sign Language (ISL), Artificial Neural Network (ANN), Artificial Bee Colony (ABC), Social Spider Optimization (SSO) and gesture to text.**

1 INTRODUCTION

Language is the prime processes of communication of individuals. Sign is the most experienced process for communication of the primitive man when there is no appropriate language. These days the sign language is similarly favored among the deaf-dumb people [1]. Deaf people utilize sign language as their medium of communication [2]. Deaf individuals make real issues when sharing their feelings the all-inclusive community who cannot grasp their Sign Languages [3]. The basic research related to sign language recognition expresses that there is a need of wonderful advance in this domain [4]. Sign language is a computer vision based language for deaf and hearing individuals, which includes utilizing hands, face and body [5]. Thus, it bargains change of transmission aptitudes among common creatures and gives restoration to discourse among unhearing and quiet person [6].

Each nation utilizes their own native language according to sign language is worried about their own syntactical and grammatical meaning. Like British Sign Language (BSL) and American Sign Language (ASL), the language which is being utilized as a part of India is called Indian Sign Language hereafter ISL [7]. ISL utilizes both single hand and twofold hands to make signals to speak to the vast majority of the alphabets; ISL utilizes both static and dynamic sort hand gestures [8]. In these, displaying of the hand image was performed to break down the hand poses by considering physiological limitations of hand viz., finger joint developments with high degree of opportunity, joint angle limits, development sorts, flexion and adduction/abduction of metacarpophalangeal (MP) joints [9]. In this proposed a framework, which can perceive the various alphabets of Indian Sign Language for Human-Computer cooperation giving more precise outcomes in any event conceivable time. It will not just profit the deaf and dumb individuals of India additionally can utilize as a part of different applications in the innovation field [10].

Indian sign language gesture is the method for building up association amongst human and human, human and robot. It is useful for hearing impeded people. There are numerous vision based gesture recognition strategy have effectively created here we will examine few of them [11]. Currently, there are several algorithms that permit playing out these procedures, however a hefty portion of them are recognized by the productivity, achievability, execution and inconvenience when they are implemented [12]. The recognition technique comprises of a directed and an unsupervised training procedure [13]. In this recognition system, we have utilized an arrangement of features for training and testing of ANN [14]. Artificial Neural Networks have been utilized generally to solve building and modern issues. On account of the prominence of ANNs, communication via gestures analysts have connected this algorithm to unravel their problems [15]. The investigations are directed on gestures of English alphabets and numbers by utilizing computerized image processing techniques and Neural Networks. The created framework changes over motion indications of Indian sign language into text [16]. The principle reason of these advances turns out to be more prevalent is on the grounds that it can be connected into a wide range of fields effortlessly and efficiently [17].

2. Literature Review

Gurwinder Kaur *et al.* [18] 2016, had recommended to build up a framework which perceive particular human hand gesture features from images and utilize these features to pass on data for machine, for example, HCI (Human Computer Interaction). Another strategy that backings the hand motion acknowledgment framework in the static shape, utilizing SIFT feature extraction with feed forward neural network utilizing MATLAB. During the time spent hand gesture recognition framework there are many difficulties tended to as: Illuminance conditions with the end goal that a little change in the lighting conditions impacts gravely on extraction handle like shading from which may deliver misclassification issue. Finally, the transformation issue, as from various images it was hard to speak to features of different hand positions.

Deepali Kaushik *et al.* [19] 2016, had prescribed a methodology for recognize the hand gesture in the midst of human–computer association. Frequently Hand gesture recognition framework was illustrated to such degrees that no require any unprecedented gear other than webcam. Human-Computer Interaction (HCI) was the examination of participation among clients and computers. Their principal target was to research the neural network-based approach to manage the recognition of the hand gestures. Had been used presentation histogram algorithm that will recognize hand gesture specifically a subset of ISL (Indian sign language). Finally, the last structure was completed with a perceptron network.

Paulo Martins *et al.* [20] 2015, had proposed a review on potential innovation answers for upgrading the communication procedure for deaf people on e-learning stages through interpretation of Sign Language (SL). Considering SL in its worldwide extension as a spatial-visual language not limited to gestures or hand/forearm development, but rather additionally to other non-skill markers, for example, outward appearances, it was important to find out whether the current innovation arrangements can be viable alternatives for the SL coordination on e-learning stages. The investigation demonstrate that some interesting technology solutions are under innovative work to be accessible for digital platforms in general, however yet some basic difficulties must illuminated and a successful coordination of these advances in e-learning stages specifically was as yet lost.

Joyeeta Singha *et al.* [21] 2013, had arranged Sign Language Recognition was a standout amongst the most developing fields of research today. Numerous new strategies had been created as of late in these fields. Here in that paper, had proposed a system utilizing Eigen value weighted Euclidean distance as a classification technique for recognition of different Sign Languages of India. The system involves four sections: Skin Filtering, Hand Cropping, Feature Extraction and Classification. 24 signs were considered in that paper, each having 10 samples, accordingly a sum of 240 images was considered for which recognition rate got was 97%.

Qutaishat Munib *et al.* [22] 2007, had proposed the work displayed in that paper plans to build up a framework for programmed interpretation of static gestures of alphabets and signs in American sign language. In doing as such had utilized Hough transform and neural networks, which was trained to recognize signs. An image was prepared and changed over to a component vector that contrasted and the feature vectors of a training set of signs. The system was implemented and tried utilizing an informational collection of 300 specimens of hand sign images; 15 images for each sign. Tests uncovered that framework could recognize selected ASL signs with an accuracy of 92.3%.

3. Proposed Methodology

In this proposed method Indian sign language (ISL) intent to convert in to text, this entire methodology applies on real time videos. Initially, frames are segregate from video for further process. The segregated frames (images) from the video are in the form of RGB band and it convert in to HSV band. Then we segment the areas of a particular S band of HSV image; for segmentation, Otsu's method utilizes automatically to perform the histogram shape-based image threshold or reduction of HSV image to a binary image. After completing this segmentation process, the binary-segmented image occur, in this image the segment object as white in color and remaining parts are black in color. Sometimes there is a chance for white in corner of the image that should remove in this process. In this paper, for enhancing the segmented image the new morphological operator using dilation process is discuss. Finally, the thin image is changed in to thick image the balance-unwanted parts are removed and then the thick image is taken for region props process. It can be used to measuring the required properties for object. In the hand object, the white pixel values replace from the same coordinate matrix of original image pixel values. From this technique, the RGB hand image is predicted then the image taken to feature extraction process. Two different techniques such as Hierarchical Centroid Shape Descriptor (HCSD) and Gray-Level Co-Occurrence Matrix (GLCM) utilized. After feature extraction Artificial Neural Network (ANN) classifier, take place. Initially, utilizing default ANN with single hidden layer having ten neurons in it. Amid, Levenberg-Marquardt back propagation behaves literally well in training section for predicting ISL image to text. For optimizing the hidden layer and neuron of ANN structure, the optimization technique is used. From the three-optimization techniques, Social Spider Optimization (SSO) Algorithm behaves literally well and fix appropriately in this Hidden layer and neurons optimization problem.

3.1 Preliminary process

In our work the real time Indian sign language (ISL) video file cannot use directly for predicting the text, so the captured video convert in to frames. The segregated frames (images) from the video are in the form of RGB band converted to HSV band. RGB is an additive color model, means different proportions of Red, Blue and Green light can be utilize to produce color. In this RGB band, how much of Red should I add to make it appear more natural, for stuff like this, individuals came up the Hue, Saturation and Value (HSV) band. Then we segment the areas of a particular S band of HSV band image in the upcoming segmentation process.

3.2 Segmentation process

Otsu's utilize automatically to perform histogram shape-based image thresholding or the reduction of a HSV image to a binary image. The algorithm of Otsu's method assumes that the image to be thresholded contains two classes of pixels or bi-modal histogram (e.g.

foreground and background) that calculates the optimum threshold separating those two classes so that their combined spread (intra class variance) is minimal.

In Otsu's method, we exhaustively search for the threshold that minimizes the intra-class variance, which define as a weighted sum of variances of the two classes:

$$\sigma^2{}_{\varphi}(t) = \varphi_1(t)\sigma^2{}_1(t) + \varphi_2(t)\sigma^2{}_2(t) \quad (1)$$

Where, weights φ_i are the probabilities of the two classes separated by a threshold t and $\sigma^2{}_i$ variances of these classes. Otsu shows that minimizing the intra-class variance is the same as maximizing inter-class variance:

$$\sigma^2{}_a(t) = \sigma^2 - \sigma^2{}_{\varphi}(t) = \varphi_1(t)\varphi_2(t)[\gamma_1(t) - \gamma_2(t)]^2 \quad (2)$$

Which is expressed in terms of class probabilities φ_i and class means γ_i.

The class probability $\varphi_1(t)$ is computed from the histogram as t:

$$\varphi_1(t) = \sum_0^t R(i) \quad (3)$$

While the class mean $\gamma_1(t)$ is:

$$\gamma_1(t) = \sum_0^t R(i) * x(i) \quad (4)$$

Where $x(i)$ is the value at the center of the i^{th} histogram. Similarly, we can compute $\varphi_2(t)$ and γ_t on the right-hand side of the histogram for bins greater than t. The class probabilities and class means can be compute iteratively. This idea yields an effective algorithm.

Algorithm for Otsu's Method

- Compute the histogram and the probabilities of each intensity level
- Set up initial $\varphi_i(0)$ and $\gamma_i(0)$ level.
- Step through all possible thresholds $t=1$.... maximum intensity
  - Update φ_i and γ_i
  - Compute $\sigma^2{}_a(t)$
- Desired threshold level corresponds to the maximum $\sigma^2{}_a(t)$.

After completing this segmentation process, the binary-segmented image is occurred. In this image the segmented object as white in color and remaining parts are black in color. Sometimes there is a chance for white in corner of the image that should be removed in this process.

3.3 Morphological operation

Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image. The dilation operation usually uses a structuring element for probing and expanding the shapes contained in the input image.

The value of the output pixel is the maximum value of all the pixels in the input pixel's neighborhood. In a binary image, if any of the pixels is set to the value 1, the output pixel is set to 1.

Mathematical morphology is an important theory in image processing and pattern recognition. The basic theory of mathematical morphology is set theory. Suppose there are two sets: the original image $g(y,z)$ and structuring element $A(u,v)$. (y,z) and (u,v) are the pixel coordinates of g and A, respectively. The morphological dilation, represented by $g \oplus A$, is defined as follows.

$$g \oplus A(y,z) = \max_{u,v}(G(y-u, z-v) + A(u,v)) \quad (5)$$

If the structuring element is flat structuring element which means $A(u,v) = 0$, the is simplified as follows.

$$g \oplus A(y,z) = \max_{u,v}(G(y-u, z-v)) \quad (6)$$

In this paper, for enhancing the segmented image the new morphological operator using dilation process is discuss. Finally, the thin image is change in to thick image the balance-unwanted parts were remove, and then the thick image taken for region props process underneath.

3.4 Region props process

A region prop is an image processing toolbox function available in MATLAB that allows users to measure/extract a set of properties for an image. The image labeled using the values obtained from the region. The maximum pixel value regions taken and the balance regions removed. At the end, the specified white hand object occurred from the maximum pixel value. The syntax for region props is:

$$S = region\ props(1, properties) \quad (7)$$

It can be used to measuring the required properties for object. In the hand object, the white pixel values replaced from the same coordinate matrix of original image pixel values. From this technique, the RGB hand image is predicted then the image taken to feature extraction process beneath.

3.5 Feature Extraction

In this feature extraction, two different techniques such as Hierarchical Centroid Shape Descriptor (HCSD) and Gray-Level Co-Occurrence Matrix (GLCM) performed. The Hierarchical Centroid Shape Descriptor (HCSD) is a binary shape descriptor built with the centroid coordinates extracted from a binary image. It extracted recursively by decomposing the image in sub-images. Because an image can be described by the spatial distribution of pixels, this method is based an image decomposition in the pixel domain by using kd-tree algorithm. The attained 128 features extracted from HCSD further utilized in classifier. Alongside the Gray-Level Co-Occurrence Matrix (GLCM) functions characterize the texture of an image by calculating how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix. In this, seven additional features for betterment in predicting text namely auto correlation, cluster shade, dissimilarity, Energy, Entropy, Homogeneity and Maximum probability.

3.6 Artificial Neural Network (ANN) classifier for predicting

At this point, we utilize Artificial Neural Network (ANN) classifier 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 behaves literally well in training section for predicting ISL image to text. 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. For optimizing the hidden layer and neuron of ANN structure, the optimization technique is used. From the three optimization techniques, Social Spider Optimization (SSO) Algorithm behaves literally well and fix appropriately in this Hidden layer and neurons optimization problem.

3.7 Social Spider Optimization (SSO) Algorithm

In this paper the procedure of proposed swarm intelligent determined by motivating the behavior of social-spider colony. Now, communal web is a solution space where all the social-spiders interrelate to each other. Spider location in the communal web is symbolize by solution, each spider receive weight in view of fitness value of social spider. This algorithm included of two part spiders specifically males and females, each individual gender demeanor by a set of special evolutionary operators, which emulate various cooperative behaviors that are commonly assume inside the colony.

Attractive features of social-spiders are the enormously female-biased populations. The algorithm starts by describing the number of female and male spiders that will depicted as individuals in the search space. The number of females Sp_{Nf} randomly chose inside the extent of 65–90% of the whole population N_S. Thusly, Sp_{Nf} computed by the supplementary condition:

$$Sp_{Nf} = floor[(0.9 - rand.025).N_{Sp}] \quad (8)$$

In spite of the fact that floor () maps a genuine number to an integer number where rand is an irregular number between [0, 1]. The number of male spiders Sp_{Nm} processed prepared as the supplement among N_{Sp} and Sp_{Nf}. It is delineate beneath,

$$Sp_{Nm} = N_{Sp} - Sp_{Nf} \quad (9)$$

Therefore, the complete population Sp_P, composed by N_{Sp} elements separated in two sub-groups Female (F) and Male (M).

3.7.1 Initialization

Initially random solution generated for Social Spider Optimization (SSO) strategy, length of the solution P_l relies upon first position value (i.e) assume if the first position random produced value is n then P_l will be n+1.

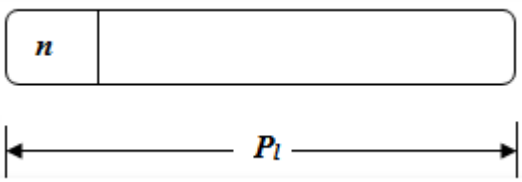


Figure-1, population generation constrain

Where, n represent position is for placing number of hidden layers; P_l represent length of the population; let, n is accept to be six then the population length is $6+1=7$. From this, n placing position (first position) for choosing hidden layer count and remaining six positions for placing neuron count in every six hidden layer. The constrain for generate this initial population is $1 \geq n \leq 10$ for hidden layer count, $1 \geq n_r \leq 30$ for neuron count, $-1 \geq w \leq 1$ for weights in the neuron.

The algorithm begins by presenting the set Sp_P of N_{Sp} spider positions. Such values are randomly and consistently disseminated between the pre-demonstrated upper initial parameter bound pr_j^{high} and the lower initial parameter bound pr_j^{low}, additionally as it depicted by the accompanying expressions.

$$f_{i,j}^0 = pr_j^{low} + rand(0,1).(pr_j^{high} - pr_j^{low}) \qquad (i = 1,2..Sp_{Nf},\ j = 1,2,..n) \quad (10)$$

$$m_{k,j}^0 = pr_j^{low} + rand(0,1).(pr_j^{high} - pr_j^{low}) \qquad (k = 1,2..Sp_{Nm},\ j = 1,2,..n) \quad (11)$$

Whereas, zero signals the initial population; *j*, *i* and *k* are the parameter and individual index in that order and the function rand generate random values between (0,1). Hereafter, $f_{i,j}$ is the j^{th} parameter of the i^{th} female spider position. By evaluating the radius of mating by then,

$$r = \frac{\sum_{j=1}^{n}(pr_j^{high} - pr_j^{low})}{2.n} \quad (12)$$

3.7.2 Fitness computation

This calculation function manipulate for analyzing the generated random/updated solution fitness.

$$f_i = \frac{Correctly\,predicted data}{Total\,no.of\ data\ utilize\ for\ validation} \quad (13)$$

From the aforementioned calculation, the weight (w_i) value is use to compute for acquired fitness to improve the probability of expanding opportunity to produce fine tune solution for next iterations in order to achieve optimal make span time in short interval.

$$w_i = \frac{J(Sp_{pi}) - worst_{Sp_p}}{best_{Sp_p} - worst_{Sp_p}} \quad (14)$$

Where $J(Sp_{pi})$ is the fitness probability analysis got by the assessment of the spider position S_{pi} concerning the objective function $J(.)$. The values $worst_{Spp}$ and $best_{Spp}$ characterized as takes after

$$best_{Sp_p} = \min_{k\in\{1,2,..N\}}(J(Sp_{pk}))\ and \qquad worst_{Sp_p} = \max_{k\in\{1,2,..N\}}(J(Sp_{pk})) \quad (15)$$

3.7.3 Modeling the vibrations via communal web

To transmit information among the colony individuals, the common web used as a component. The vibrations depend on the weight and distance of the spider, which has made them. With a particular true objective to copy this method, the vibrations saw by the individual *i* because of the information transmitted by the member *j* showed by the accompanying condition.

$$Vib_{i,j} = w_j.e^{-d_{i,j}^2} \quad (16)$$

Wherever the $d_{i,j}$ is the Euclidian distance between the spiders *i* and *j*, such that $d_{i,j} = ||Sp_{pi}\text{-}Sp_{pj}||$.

3.7.4 Cooperative operators

There are two types of cooperative operator's specifically female cooperative operator and male cooperative operator where talked about beneath.

3.7.4.1 Female cooperative operator

A new operator is describing in order to imitate cooperative behavior of the female spider. At each iteration, the operator considers the position change of the female spider *i*. Such position alter may attract or surprise the procedure as a mix of three unique components. The first incorporates the change concerning the nearest part to *i* that holds a higher weight and makes the vibration $Vibo_i$. The second one considers the adjustment with respect to the best individual of the whole population Sp_p who delivers the vibration $Vibg_i$. At long last, the third one consolidates a random movement.

$$Vibo_i = w_o.e^{-d_{ii,o}^2},\ Vibg_i = w_g.e^{-d^2{}_{i,g}} \quad (17)$$

A uniform random number r_m made inside the range [0, 1]. In case, that r_m is smaller than a threshold PF, fascination advancement made; by and large, a repulsion movement is delivering. Thusly, such administrator can be show as represent underneath,

$$f_i^{k+1} = \begin{cases} f_i^k + \alpha.Vibo_i.(Sp_{po} - f_i^k) + \beta.Vibg_i.(Sp_{pg} - f_i^k) + \delta.(rand - \frac{1}{2}) & with \quad proability\ PF \\ f_i^k - \alpha.Vibo_i.(Sp_{po} - f_i^k) - \beta.Vibg_i.(Sp_{pg} - f_i^k) + \delta.(rand - \frac{1}{2}) & with \quad proability\ 1-PF \end{cases} \quad (18)$$

Despite the fact that *k* represents the iteration number where *α, β, δ* and *rand* are random numbers between [0, 1]. The individual Sp_{po} and Sp_{pg} speak to the nearest part to *i* that holds a higher weight and the best individual of the whole population Sp_p, independently.

3.7.4.2 Male cooperative operator

Male people, with a weight value over the middle value inside the male population, are see as the transcendent individuals *D*. Then again, those under the middle value are naming as non-prevailing *ND* males. In order to execute such calculation, the male population *M* ($M = \{m_1, m_2, \ldots m_{Nm}\}$ is organize by their weight value in diminishing request. The Vibration $Vibq_i$ saw by that individual $i(D_i)$ due to the information passed on by the part $q(D_q)$ with *q* reliably the closest female unmistakable to *i*.

$$Vibq_i = w_q.e^{-d_{i,q}^2} \quad (19)$$

Since the number of female individuals, Sp_{Nf} grows arrangements of the male population *M* as for the whole population Sp_p, the middleweight is requested by Sp_{Nf+m}. As showed by this, difference in positions for the male spider can exhibit as take after.

$$m_i^{k+1} = \begin{cases} m_i^k + \alpha.Vibq_i.(Sp_{pf} - m_i^k) + \delta.(rand - \frac{1}{2}) \; if & w_{Sp_{Nf+i}} > w_{Sp_{Nf+m}} \\ m_i^k + \alpha.\left(\frac{\sum_{h=1}^{Sp_{Nm}} m_h^k.w_{Sp_{Nf+h}}}{\sum_{h=1}^{Sp_{Nm}} w_{Sp_{Nf+h}}} - m_i^k \right) if & w_{Sp_{Nf+i}} \le w_{Sp_{Nf+m}} \end{cases} \quad (20)$$

While, $(\Sigma_{h-1}^{Sp_{Nm}} m_h^k.W_{SpNf+h} / \Sigma_{h-1}^{Sp_{Nm}} W_{SpNf+h})$ contrast with the weighted mean of the male population *M*, where the individual Sp_{pq} speaks to the nearest female individual to the male part *i*.

Two novel practices made by using this administrator. At first, set *D* of particles is charging with others in order to rouse mating and such a performance permits incorporation diversity in to the population. On other hand, the set *ND* of particles magnetize by means of male population *M*. This truth is using to somewhat control the search process as demonstrated by the ordinary execution of a subgroup of the population. Such system goes about as a filter, which keeps up a vital separation from that extraordinary individual or extremely bad person, influences the search process.

3.7.5 Mating process

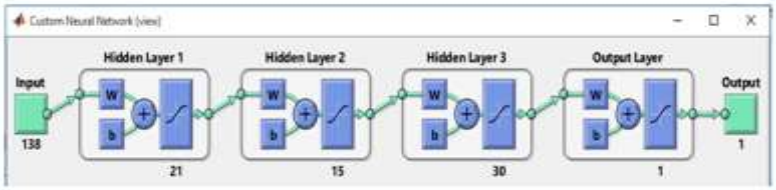
In the mating process, the weight of each included spider (elements of *Tg*) describes the probability of effect for each individual into the new brood. The spiders holding a heavier weight will probably influence the new item, while parts with lighter weight have a lower probability. The effect probability P_{Sppi} of each member is allocate by roulette technique, which is portrayed as take after.

$$p_{Sp_{pi}} = \frac{w_i}{\sum_{j \in T^k} w_j} \qquad where \quad i \in T^g \quad (21)$$

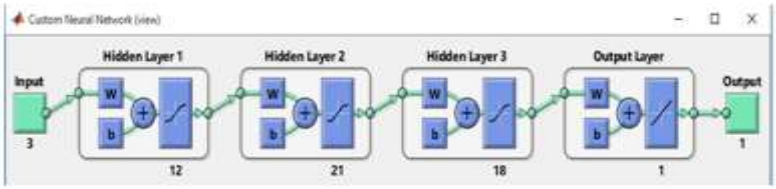
Once the new spider is made, it is appeared differently in relation to the new spider candidate Sp_{pnew} holding the worst spider Sp_{pwo} of the colony, as showed by their weight values (where $w_{wo} = min_{l\epsilon\{1,2,\ldots,N\}}(w_l)$). In the event that the new spider is superior to the most exceedingly worst spider, the new one replaces the most noticeably worst spider. Something different, the new spider is discarded of and the population does not endure changes. In the event that there ought to emerge an event of substitution, the new spider expects the gender and index from the supplanted spider. Such reality ensures that the whole population Sp_p keeps up the first rate amongst female and male individuals. Under this operation, recently made particles locally abuse the search space inside the mating range to find better individuals.

4. Results and discussion

This section discuss about different investigation with results from dissimilar techniques. Here, nine distinctive training algorithms in the conventional network structure having single hidden layer incorporates ten neurons in it. In that investigation levenberg marquardt (lm), demonstrate its superiority contrast with all training algorithms, at that point by fixing lm as a training algorithm. Additionally, redesign the conventional structure the procedure includes two different optimization techniques specifically ABC and SSO amid, SSO demonstrate its lead in this entire investigation. Give us a chance to converse about one by one examination with various optimization techniques in detail.



(a) Optimal ANN structure attain from ABC



(b) Optimal ANN structure attain from SSO

Figure 2, optimal network structure for ABC and SSO

In figure 2, two individual network structures have appeared and the proposed SSO having three hidden layer and neurons in it are 12, 21 and 18 respectively. On other, hand ABC having three hidden layer and neurons in it are 21, 15 and 30, apart from its predicting accuracy the structure itself reveals the computational time consumes in this procedure. If number of hidden layer increase the processing time also increase, this statement clearly shows that the proposed SSO consumes less time in this computation procedure.

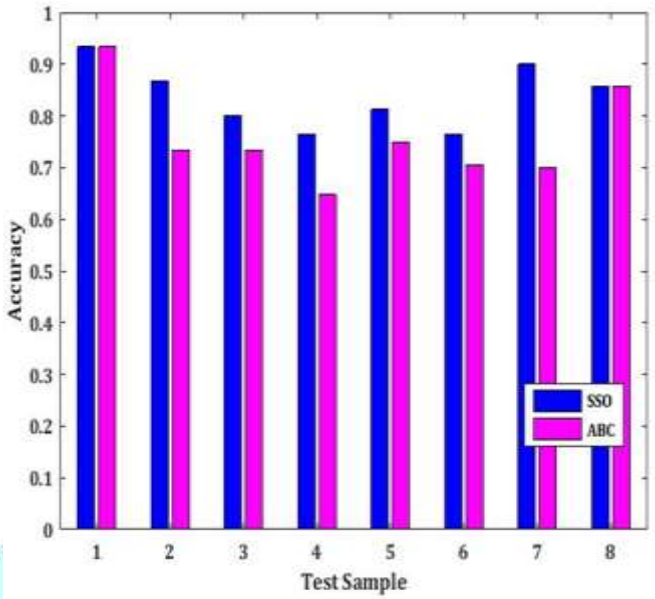
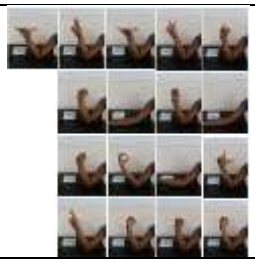


Figure 3, Comparison graph

From the beyond illustration it is quite evident that the proposed SSO having superior accuracy value over ABC. The average accuracy value for SSO in aforementioned validation is 83.73% and ABC having 75.75%, the proposed SSO having 8% greater impact over comparative technique. This accuracy based revealed output for individual techniques obviously explained in table-1.

Table-1, Implemented results from two methodologies

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
	THANK FOR HELPING	THFNL FOR HRLYING	THDNK FER HELYIFG
	VERY HAPPY	VETYBHAPPN	VERX HAPPY
	WELCOME	WELCOMH	WELCONE

4.1 Convergence Graph

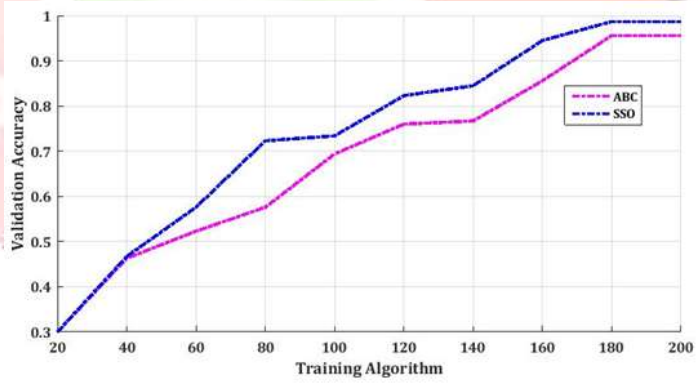


Figure 4, Convergence graph

This section carryout different optimization technique involve in designing the ANN structure namely ABC and SSO amid SSO converge faster than other at a same time accuracy reveal by the proposed SSO also good compare with contest technique. The straight competition between SSO and ABC up to 40th iteration then SSO varies high up and saturate at 180th iteration.

5. Conclusion

It is quite evident from the implemented results, that incorporation of optimization techniques benefits the purpose of gesture prediction as text. Here, couple of swarm intelligence contest in this context amid SSO reveals 66.66% superior results over ABC and remaining results similar in both cases. The average results attain from ABC and SSO are 75.75% and 83.73% respectively. Training place a vital role in performance enhancement, in future incorporation of massive frames of real time gesture image will certainly enhance the preciseness of ANN structure without any doubt. In addition to that, development in designing an optimization algorithm also elevates the overall preciseness of ANN.

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