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# Optimization of Gesture Recognition Algorithm-aid of Artificial Neural Netwok

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#### **Abstract**

**Objective:** The Objective of our research is to establish an Artificial Neural Network (ANN) model for Braille coded gesture pattern recognition process and to optimize the weight of the ANN model using optimization algorithms. The ANN utilized to predict the outputs such as right gesture, left gesture, top and bottom gestures of the known input values. **Methods:** To optimize the weight of the ANN structure optimization techniques such as Genetic Algorithm (GA), Differential Evolution (DE), and Lion Algorithm (LA) are utilized to optimize the weights such as number of input neurons ( $\alpha$ ) and number of hidden neurons( $\beta$ ). **Findings:** The optimum results show that the attained empirical error values and predicted values are equal to zero in designed network. The Convergence graph demonstrates the fitness rate with minimum error 0.33 between different iterations for three optimization algorithms. The Lion algorithm results the optimal fitness value of Braille Coded Gesture ANN model. **Applications:** The lion algorithm can be utilized for gesture recognition in touch enabled devices in the area of human computer interaction.

**Keywords:** Artificial Neural Network, Braille Code, Gestures, Lion Algorithm, Territorial Defense, Territorial Takeover, Touch Screen, Velocity

# 1. Introduction

The improvement of touch screens responsive multi-finger inputs has illuminated a resurgence of passion for the innovation's ubiquity. Gadgets like the Apple iPhone are a section of a pursuit to exploit this wield of attention<sup>1</sup> In genuine living, visually impaired individuals take part in chess or some other comparable diversion because of unique sheets where cells have different examplessotheycanbeperceived by touching them<sup>2</sup> Braille Touch offers a superior arrangement, minimal effort equipment, and sufficient programming execution the eight-wedge screen design that demonstrated a checked change in speed of data input, the positive feedback from the members and error rate. Huge contrasts in the size, pace and state of the motions performed by vision enabled individuals versus visually impaired individuals. The majority touch screens gave hardly any or no expedient features, abandoning

them to a great extent unusable by visually impaired people<sup>3</sup>.Braille points are shifted arrangement plans of raised specks indicating characters that are distinguished by touch. For the most part Braille with  $six(2\times3)$  dots focuses the indication of one character, the measure of a point being around 1-2 mm and the separation between them being 2-4 mm, the standard shifting by country4. A common Braille page contains 25 lines with 40 braille characters in each line. The braille code has two levels of framework, termed Grade-I and Grade-II. The Grade-I braille is a direct translation of print letters to braille cells. One print page is comparable to around one and a half pages of Grade-I1 Braille, which involves complete employment of contractions<sup>5</sup>. For the visually impaired, eyes-free content passage will be a pervasiveneed, particularly when utilizing versatile registering gadgets. Current arrangements are convincing yet have huge disadvantages. Numerous programming solutions

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for versatile eyes-free content section are less expensive than the equipment options<sup>6</sup>. Human hand motions are a method for nonverbal connection among individuals. They set out from basic activities of indicating at items and moving them around the more intricate ones that express our emotions or permit us to converse with others2. The framework is focused around afinger-delicate single touch screen interface and empowers clients having utilize the signals to in stinctiver apid interface. Related WSN frameworks, for example, Code Blue and have front-end applications yet none of them have as firm an emphasis on the errand and clients. The prominence of this issue increments as if the load in the screen with components like interface on which the letters are set on screen. Apple's Voice over, empowers a visually impaired individual to beat these issues by offering sound-related input of the visual components on the screen<sup>2</sup>. Even if unwieldy and unstable, it was completely compelling at making hers nicker at what we acknowledged were content messages from a companion. She was like any other teen with a cell phone, a master at messaging. The main distinction was that she was doing it onthebrailleconsoleofaBrailleSensePlus<sup>10</sup>. As mobile touch screen gadgets get to be progressively omnipresent, they are likewise receiving to be more open to individuals with visual disabilities. The iPhone will be the just touch screen phone suggested by the National Federation of the Blind (NFB) theAmericanFoundationfortheBlind<sup>11</sup>. The relationship between touch-screen signals capacity and interface is especially extraordinary, it's not simple to execute and keep up generally poor adaptability and reusability. Hence, for simplicity of execution, the guardian structure can be utilized to exemplify the touch-screen signals; the child that acquires the guardian structure can have the impact of touch-screen<sup>12</sup>. According to the content passage system, a input motion can create a whole word or a shorter content lump. Equally they have merits and demerits. With the previous routines, the input of the space character can be saved, since it is consequently entered toward the end of a gesture<sup>13</sup>. The signal trail communicates the verifiable touch signals in scanning of an article. We give careful consideration to the way that the clients make particular touch signals when they experience an appealing phrase. The samples of particular touch motions are gotten from chronicled signal trails of clients when clients have experienced alluring expressions in the past14. Since Braille is in wide use by hard of hearing visually impaired individuals, we have made anovel path to present Braille on standard cell phones, called V-Braille, utilizing touch-screen and vibration capacities. The preparatory assessments of V-Braillewith hard of hearing visually impairedindividuals who dependon perceptible communication 15. They addition ally help TTS (text Entry Techniques) procedures and perceptible feedbacks which help to enter content with out viewing the screen. In spite of the fact that the sestrategies attemptto make touch screen gadgets more clients well-disposed for visually disabled people 16.

In 2014 Harish et al. Thave proposed the enabling of visually impaired to employ advanced mobile phones with the increment in the quantity of cell phone clients, it is progressively critical to make the cell phones unwrap everybody. As indicated by the World Health Organization (WHO), 284 million individuals are outwardly debilitated around the world. It was critical that we make it simpler for such an immense populace of the world to be utilized the Smart phone gadgets much the same as some other client. Commencing the fallouts redress rates stayed relentless for Graffiti, while they plunged from 43.4% to 16.3% for Sunstrokes.

In 2014,Rodriguez-Sanchezaet al.<sup>18</sup> have proposed the cell phones for visually impaired clients could go to work from his home in a self-governing way utilizing a versatile way discovering application. The application consolidates content, map, sound-related and perceptive feedback for offering the data. Preparatory results from the study demonstrate that visually impaired individuals and constrained vision clients can successfully utilize the way discovering application without assistance. The assessment additionally affirms the handiness of developing the vibration input to pass on separation data and also directional data.

In 2013,Schmidtnet al. <sup>19</sup> have proposed the classifier for multi-touch signals tagged by clients. The layout based motion classifier permits selecting signal sorts all the more unreservedly without imperatives in regards to execution issues and considers multi-finger or bi-manual operations. The fundamental ideas of differentiating data into tokens, recovering neighborhood features, and applying another strategy for sensor combination under vulnerability are versatile to more extensive application ranges. Through the consequences testing against a set of complex specimens demonstrate that the methodology performs well and, while distinguishment advantages from more unpredictable motions, it additionally recognizes inconspicuously diverse signals.

In 2011, Oliveira et al.<sup>20</sup> have propose the Braille Type, a content section technique built with respect to the Braille letter set. Braille Type evades multi-touch motions in support of a more basic single-finger cooperation, offering few and huge targets. The performed a client study with fifteen visually impaired subjects, to survey this strategy's execution against Apple's Voice over approach. Braille type even though slower, was fundamentally simpler and less prone to errors. Through the consequences target clients would have a smoother adjustment to Braille type than to other more mind boggling routines.

In 2010,Karmakaret al.<sup>21</sup>have proposed Braille printed paper quality testing utilizing balanced camera and distinguishing specifications and Euclidean separations between them. Simultaneously, the position of the camera was settled. The paper demonstrated the Radian lens distortion. Quality change can be accomplished by giving an input in the wake of discovering the twisted edges from image process. The methodology along these lines certainly helps the visually impaired the blind reader in the way of avoiding disturbances in reading records. Through the consequences higher precision, camera alignment was vital to watch a planar design.

In 2009,Rantalaet al.<sup>22</sup> have proposed the correlation strategies were intended for perusing six-dab Braille characters from the touch screen of a cell phone. The three connection strategies, output, breadth, and cadence, empowered clients to peruse Braille characters each one in turn investigating the characters through sensing a rhythmic sample embedded on the screen. A mean gratitude70 percent precision was discovered while the rate of introducing a solitary letter was about multiplied with the other examination. The resultsshow the worldly material input that the Braille coding was used to transmit single-character data.

# 2. Proposed Methodology

The significant intention of the proposed method to predict the gestures in Braille codes on touch screen for blind people. The ANN<sup>23</sup> with the optimization technique lion algorithm is utilized to predict the output such as top gesture, bottom gesture, left gesture, and right gesture with the known input values as Braille touch based a hand finger gesture X coordinate values lies on X axis value, Y coordinate values lies on Y axis value, swipe threshold velocity, swipe minimum distance, pixel rate and velocity of X and Y. Initially anANN<sup>24</sup>model structure is formed

with an input layer in the first, in the middle the hidden layer and the output layer at last. This network structure is utilized for the known data and this process is the preliminary stage in the prediction process. Meanwhile we use 80% of known dataset values for training process and we use 20% of dataset for validating the developed ANN Structure<sup>25</sup>. Optimization structure is implemented in ANN structure to achieve the optimal weight  $\alpha, \beta$ . The optimization of the system reduces the error value of the network. Several optimization techniques like GA, DE and LA employed effectively to establish the optimal weight of the network model. The ANN with LA attains the optimal weight  $\alpha$  and  $\beta$  to predict the correct gesture outputs.

#### 2.1 Data set Generation

Several gestures and finger movements have been developed for the Braille system which has two columns and three rows. The finger gesture is used to interact with the touch mobile through which a person can enter characters and numbers. We have considered a five basic gestures to formulate a gesture pattern for each character. To predict different gestures such as left, right, top and bottom by utilized the hand finger gesture coordinate such as X Coordinate X axis value, Y coordinate on Y axis value, swipe threshold velocity, swipe minimum distance, pixel rate and velocity of X and Y. The gestures based condition is shown in Table 1.

 Table 1.
 Conditions for different gestures

Sl.no	Gesture	Condition
1	Тор	$ \begin{cases} \{ & (Y1 < Y2) \\ (abs(Y2 - Y1) \times p_r) > S_d \} \\ (V_Y > S_r) \\ \} \end{cases} $
2	Bottom	$ \begin{cases} \{ & (Y1 > Y2) \\ (abs(Y1 - Y2) \times p_r) > S_d \} \\ (V_Y > S_r) \\ \} \end{cases} $
3	Left	$ \begin{cases} (X1 < X2) \\ (abs(X2 - X1) \times p_r) > S_d) \\ (V_X > S_r) \\ \end{cases} $
4	Right	$ \begin{cases} (X1 > X2) \\ (abs(X1 - X2) \times p_r) > S_d \end{cases} $ $ (V_X > S_r) $ $ \} $

#### From the table

Y1 and Y2 is a hand finger gesture Y coordinate, X1 and X2 is a hand finger gesture X coordinate,  $V_X$  and  $V_Y$  Velocity of X and Y coordinate,  $P_r$  is a pixel rate,  $S_d$  Swipe minimum distance,  $S_r$  Swipe threshold velocity.

In mention conditions based predict the gestures. Hand finger gestures coordinate X1, X2, and Y1 and Y2 values from -1 to 1. The pixel rate is considering as 200 px, swipe minimum distance is 100 px; swipe threshold velocity is 2000 px. In this Constrains based generate the data set.

#### 2.2 Artificial neural network

The ANN system is a modified computational model <sup>26,27</sup>. The computational model is a copy of the neural structure and working of the human brain. The human brain is composition of interconnected structure of misleadingly delivered neurons which functions as route ways for information exchange. Artificial neural systems are adaptable and versatile, learning and conforming with every diverse

inner or outer boost. The ANN $^{22}$  models are consumed as a part of arrangement and example gratitude frameworks, information handling, mechanical technology, and demonstrating. Subsequent to research work, the approved framework is utilized for assessing the dataset with the extent of 80:20 rate ranges. Designed for improving weights  $\alpha$  and  $\beta$  diverse improvements systems are utilized, for example, GA, DE and LA frameworks are adequately used to land at the perfect weights of the target capacity, which is given by the contrast between the test and gauge values.

The essential structural planning of the artificial neural system is indicated in Figure 1. It has the multi-layer neural system. The system encompasses three basic layers, such as Input Layer, Concealed layer, Output Layer. Each layer contains various neurons and all layers are united by the neurons. In view of the associations, the ANN systems are of two sorts viz. bolster forward system and feedback system. Now, the feed forward system is utilized. In this system, the signal or information is transmitted from front to over with adjusted stream and there is no opposite transmission of the information stream. In this

Table 2. Pseudo code for the proposed method

```
1.
      Structure initialization
       Initialize the input (I_i; i = 1,2,...6) I_i = \{X_1, X_2, Y_1, Y_2, V_X, V_Y\}
       Initialize the input layer weight \{a_i; i=1,.....6 \text{ and } -10 \le a \le 10\}
       Initialize the hidden layer weight \beta_{ii}; j = 1,2....20 and -10 \le \beta \le 10 }
       Number of hidden layer (L = 1)
       Number of output layer (O = 1)
      Input layer
 2.
Basic function computation (F_k)
      Hidden layer
       For optimizing weight (a_i and \beta_i) by using lion algorithm
 4.
      Lion algorithm
       Initialize the weights (a_i, \beta_i)
       Fitness computation (F_i) for (I_i)
       Mating
       Cub growth function
       Territorial defense
       Territorial takeover
       Store the best solution so for attained
       Stop until optimal solution (F_{optimal}) attained
      Output layer
       Obtain the basics function of the output layer unit (O_{\iota})
       Find the error value (E_i)
```

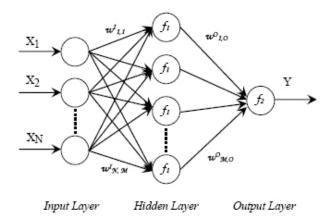


Figure 1. Neural network architecture.

methodology essential ANN structure, the shrouded layer is one and the hidden neuron is 1 to 20. The above mentioned mathematical statement  $L_k$  IS an input layer parameter,  $O_k$  is a output layer parameter and R is a real number.

#### 2.2.1 Structure Initialization

Structure initialization starts with initializing the input layer weight  $\alpha_j$  and output layer weight  $\beta_{ij}$  for six input values respectively. The input values  $I_i$  such as X coordinate value  $(X_1, X_2)$ , Y coordinate value  $(Y_1, Y_2)$  and velocity  $(V_X, V_Y)$ .

#### 2.2.2 The Input Layer

The input layer is collection of multiple input neurons. Each input neuron is connected with the hidden layer neurons. The input layer has four input neuron such as  $\mathbf{i}_1, \mathbf{i}_2, \dots \mathbf{i}_n$ . The inputs are  $\mathbf{I}_1, \mathbf{I}_2, \dots \mathbf{I}_n$  each neuron possesses the weight which is represented as the  $\mathbf{i}^{\text{th}}$  input layer neuron connected with the  $\mathbf{j}^{\text{th}}$  neuron of the hidden layer like  $\beta_{11}, \beta_{12}, \beta_{13}, \dots, \beta_{ij}$ . Input layer basic function equation which is defined as  $L_k$  where L is a Basic function of hidden neurons, represents the number of hidden units,  $\beta$  represents the weight of the input layer neuron, N represents the number of data and I represents the input values. Based on these values calculate the basic function

$$F_k = \sum_{i=1}^N I_i \times \alpha_i$$

where,  $F_k$  is basic function;  $\alpha_i$  is weight of input layer that is number of inputs.

where,  $F_k$  is a basics function,  $a_i$  is a input layer weight and  $a_i$  is a number of input

# 2.2.3 Hidden Layer

The hidden layer contains a number of neurons which are named as  $h_1, h_2, \ldots, h_n$ . The hidden layer and the output layers are connected using neurons. Weight obtaining equation is  $F_k$ , where,  $\alpha_i$  is a number of input layers, and the weight  $\alpha_j$  and  $\beta_j$  based obtain the activation function. In this arithmetical demonstration, Lion Algorithm(LA) strategy is observed to achieve the optimal weight of ANN model.

# 2.3 Lion Algorithm

The lion algorithm looks ideal arrangement focused around the two special lion conduct, specifically territorial defense and territorial takeover. The territorial defense is carried over in between inhabitant males and roaming males and the territorial takeover is performed in between the old regional male and new regional male. Our inventive system has effectively assessed the measurement of distinctive signals, for example, left, right, top, and bottom. The assessment parameters are X coordinate, Y coordinate, swipe threshold speed, swipe minimum distance, pixel rate and speed of motions on X, Y axis applied in LA procedure.

#### 2.3.1 Procedure Initialization

The parameters such as the input, hidden layer weights  $\alpha$ ,  $\beta$  are initialized. The initial solution in male is  $a_i^m$ ,  $\beta_j^f$ . The initial solution in female is  $a_i^f$ ,  $\beta_j^m$ , and I is number of solutions. The weights  $a_i^f$ ,  $\beta_j^f$  are combined as  $X_i^f$ 

$$X_{i}^{m} = \left\{ X_{0j}^{m}, X_{1j}^{m}, \dots, X_{ji}^{m} \right\} \quad X_{i}^{f} \left\{ X_{0j}^{f}, X_{1j}^{f}, \dots, X_{ji}^{f} \right\}$$

where,  $X_i$  defines an initial solution,  $i\varepsilon$  [1, 2, ... 10] and  $j\varepsilon$  [1, 2, ... 140],

i is the number of solutions,

j is length of solution,

 $\mathbf{X_i} = [(No\ of\ hidden\ neuron\ imes No\ of\ input\ data) + No\ of\ hidden\ neuron]$  (1)

where, Total input = 6; Hidden neuron(h)= 20.

Based on equation (1), the attained solution length is 140 and the solution range lies between  $(-10 \le x_{ij} \ge 10)$ . According to the initial solution based four outputs such as different gestures are evaluated.

#### 2.3.2 Fitness Function

Evaluate the fitness value of each male and female solution and then calculate the best solution values.

$$F_{i} = \sum_{j=1}^{h} \alpha_{j} X \left[ \frac{1}{1 + \exp\left(-\sum_{i=1}^{N} I_{i} \beta_{ij}\right)} \right]$$
 (2)

where, Fi is the fitness function,  $\alpha$ ,  $\beta$  are weights, I is the input parameter, I is the number of inputs; j is the number of weights and h is the number of hidden neurons.

# 2.3.3 Lion Mating

The process such as crossover and mutation was performed on generated  $X^{\textit{male}}$  and  $X^{\textit{female}}$  to carry out mating process. The result of mating process produces  $X^{\textit{cub}}$  through the implicit process such as crossover and mutation those are referred as mating operators.

#### 2.3.3.1 Lion Crossover

Reproduction contains the crossover and mutation operation. The hybrid operation has numerous strategies to create the cubs. They are one point, two focuses, uniform, and number arithmetic crossover, in these procedure single point hybrid utilized. A hybrid works by haphazardly selecting a hybrid point inside preparations, then exchanging the male and female arrangements between these focuses to create two new cubs.

#### 2.3.3.2 Lion Mutation

Subsequent to the hybrid process, the cubs are mutated for expanding the productivity of the arrangement. Mutation is the capacity of the creating new cubs from the single male or female arrangement and keeps up the assorted qualities of every arrangement indicated in Figure 3. There is an opportunity to acquire a gene of a child to modify haphazardly. This delight execution is superior to the old male and female lion randomly. This pride performance is better than the old male and female lion.

#### 2.3.4 Lion Cub growth function

In cub growth function find the fitness of the mutated cub solutions, based on this fitness separate the male and female cubs that is  $X^{\text{m-cub}}$  and  $X^{\text{f\_cub}}$ . Now compare solution cubs with the old male and female solutions. The muted  $X^{\text{m\_cub}}$  and  $X^{\text{f\_cub}}$  replace the old  $X^{\text{m\_cub}}$  and  $X^{\text{f\_cub}}$  if muted X-male, X-female cubs are better than old X-male and X-female cubs.

#### 2.3.5 Lion Territorial Defense State

The next leading optimization state of lion technique is territorial defense. This is one of the essential lion administrators that direct the optimization strategy to break down the inquiry space in more extendable way. So as to overhaul the conceit, it is important to keep up cub organization steadiness among the product of female and male. The cub organization reliability is kept up by each one offspring pools that are male and female cubs and analyze the fitness of the mutated cubs. The territorial defense can be chained here as shaping migrant aliance, protraction battle and overhauls. At that point produce the traveling lion  $X^{e_{-momad}}$  arrangements and think about the fitness of the arrangements. Survival battle happens between one of the two lions of the traveling lion arrangements. The survival battle consequences approach for the preferred  $X^{e-momad}$  by the state of affairs.

$$(X^{\text{e\_momad}} < X^{\text{male}})$$
 and  $(X^{\text{e\_momad}} < X^{\text{m\_cub}})$  and  $(X^{\text{e\_momad}} < X^{\text{f\_cub}})$ 
(3)

In this conditions based find the fitness with the solution to utilize the territorial takeover process.

#### 2.3.6 Lion Territorial Takeover

The territorial takeover is performed once the cubs reach maturity level that is when the cub's age is greater than or equal to the maturity level. The cub solutions are treated as lions when they reach the level. In this compare the fitness of the new cub solutions with old solutions. The territorial takeover is performed in such

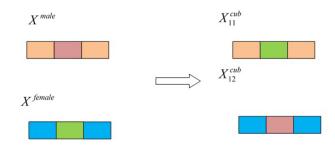
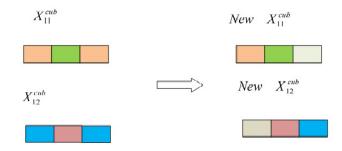


Figure 2. Double point crossover.



**Figure 3.** Mutation.

a way that X  $^{f\_cub}$ is performing better than X  $^{f\_then}$  X  $^{f\_cub}$  occupies the position of X  $^{f}$ . X  $^{f}$  takes the female rate that is 0.15.

# 2.3.7 Optimal Solution

The above mentioned process attain the optimal weights, and based on the optimal weight find the optimal which is defined as  $F_{\rm optimal}$ .

$$F_{optimal} = \sum_{j=1}^{h} \alpha_{(optimal)_{j}} * \left( \frac{1}{1 + \exp(-\sum_{i=1}^{N} I_{i} \beta_{(optimal)_{j}})} \right)$$
(4)

# 2.4 Output Layer

The output layer has a number of neurons. The hidden layer neurons are connected with the output layer neurons. Each input – hidden neuron links possess the weighted value  $\alpha_1, \alpha_2, \ldots$  The basis function of the Output units is expressed by the Equation is  $O_k$ .

$$O_k = \sum_{i=1}^n a \sigma(F_{i(optimal)})$$
(5)

$$k = 1 \text{ and } i \in [1, 2, ... n]$$

The error value equation which is defined as  $E_i$  Where,  $\alpha$  and  $\beta$  are weights and the values of weights are ranging from -50 to 50. I is set of all input parameters, the variable h is number of hidden neurons, j is the number of weights, I is the number of inputs.

$$E_{i} = \sqrt{\frac{\sum_{i=1}^{ND} (D_{i} - P_{i})^{2}}{ND}}$$
 (6)

The variables in the equation (6) are ND stands for number of Data, P stands for predicted value, D stands for desired value. The equation explains the error value calculation as the difference between the desired value and predicted value.

# 3. Result Discussion

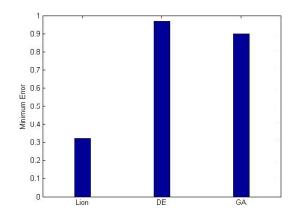
Different inputs such as X coordinate values, Y coordinate values, swipe threshold velocity, swipe minimum distance, pixel rate and velocity of X and Y and outputs are represented by top gesture, bottom gesture, left gesture, and right gesture

is obtained by utilizing the ANN. In the initial stages, the structureis trained in such a way that 80% of the concurrent dataset takes upon itself the task of training the network model, whereas the remainder representing 20% of the data focuses itself on the aspect of verification. For developing optimal artificial intelligence network we use LA.LA performs elegantly in optimizing the ANN to find the optimal solutions  $\alpha$  and  $\beta$ . With the same rigor the optimal solutions of the weight are obtained with the set input constraints with the deployment of lion algorithm. The output of the equation is modified for the least error value of the mathematical model. The ANN structure was utilized to find the True Positive(TP), True Negative(TN), False Positive (FP), False Negative (FN) for the solutions as different gestures. Based on these features obtain the statistical measures such as sensitivity, specificity and accuracy. In the Testing process, the above-mentioned parameters are calculated in any testing data and the Receiver Operating Characteristic (ROC) is drawn. The differential error between real time output and the attained output from ANN are near to zero. From the result it is proved that the evaluated output employs different gestures by utilizing the input constraints.

# 3.1 Artificial Neural Network (ANN) with Optimization Techniques

The optimization methods such as GA, DE, and LA yields the minimum error value for the optimal equation with optimal weights  $\alpha$  and  $\beta$  deployed in ANN. Out of the three optimization methods, the least error value is achieved by Lion Algorithm.

Figure 4 shows that the minimum error value of the gestures for the ANN with GA, DE and LA. The forecast values of different gestures achieved by the evaluation of the fitness of the ANN structure. ANN along with



**Figure 4.** Error graph for different algorithms.

LA attained the minimum error values of the different gestures in Braille code. In LA techniques the least error value is 0.33 which is compared to the GA the error minimized as 83.73% and the DE error minimized in 81.875%. The performance of the minimum error value compared to the other approaches 84.58% minimized and least error in test and predicted values.

# 3.2 Convergence Graph

The fitness estimation of the process is minimum error value attained in LA the convergence diagram plotted in iteration and fitness value.

The convergence graph shown in Figure 5 is the relationship between number of iterations and fitness values among the different optimization strategies such as DE, GA, and LA. The convergence graph resolves that the Lion Algorithm strategy takes the minimum iteration for to give minimum fitness convergence. LA provides the ideal result it receipts at primary greatest estimation of fitness in least iteration. The initial iteration obtains 12.5 fitness value for the LA strategy and it reaches minimum error value 0.33 attained in 42 iterations. Then the iteration is varied the performance also changing in all techniques. When the minimum fitness of the LA technique contrasted with the DE and GA the error increased by 6.65%. The maximum fitness of GA is 11.3 after 13 iterations. It is clear from the convergence graph that Lion Algorithm optimization strategy specifies the ideal fitness value with the efficient results.

# 3.3 Algorithms and Predicted Values

Eventually the ANN structure uses 80% data set in training process and 20% data set in training process. In this testing process input constraints such as X and Y coordinate value

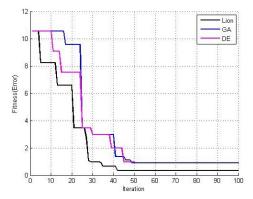


Figure 5. Convergence graph.

and the velocity of X and Y. The weight varying in -50 to 50 the gestures evaluated by utilized the LA, GA, and DE.

Table 3 shows that the predicted the top gesture for the different input values. The X coordinate X, and X, values are -1, Y coordinate Y<sub>1</sub> is -1 and Y<sub>2</sub> is -0.25 and the velocity X varying in 200 to 8200 and Y varying from 2200 to 8200.In this input values based predicted the top gesture in LA and the other gestures are in GA and DE algorithm. In the velocity of the X and Y from 4200 to 8200 the top gesture correctly identified and the varying velocity in X and Y for GA and DE the multiple gestures are identified. Top gestures identification in lion algorithm produces the 85% accuracy and the DE and GA compared to LA the accuracy is 11.26% unreliable. Consider 10 data values correctly predicted "top" gesture in 8 data for LA technique. The X velocity is 200, Y velocity is 2200 and 4200 means LA, GA predicted the bottom, right gestures, and DE predicted the left gestures.

Table 4 shows that the predicted the bottom gestures for the input values and consider the 10 data values correctly the LA predicted the bottom gesture in 7 data values. The efficiency of the LA is 82.5% its compared to the DE and GA the difference is6.56%. In this Y coordinate  $Y_1$  and  $Y_2$  is -0.25, 0.5 and -1 then the velocity is 200 to 8200. If the velocity of X and Y is 2200 means the three algorithms predicted the left gestures, similarly for each input values the gestures to be identified.

The Table 5 shows that the left gesture predicted for the LA technique the accuracy is 92.5% its compared to the DE and GA the difference is 2.56%. Consider the 10 testing data left gestures correctly predicted in 8 data only, if the velocity of X and Y is 8200,200 means LA and DE predicted the bottom gesture and the velocity is 4200, 6200 the three algorithm produce the top gesture.

In Table 6 shows that the right gesture for the different algorithms the different testing data the right gesture predicted for the eight set of testing data. The accuracy of the right gesture for the LA is 92.5%, it's compared to the GA, and DE the difference is 5.89%. If the X coordinate velocity X and Y coordinate velocity Y is 6200 means each algorithm predicted the bottom gestures.

The Figure 6 demonstrates the set of input data used in the procedure and implemented in MATLAB programming illustrates one set of input values of the procedure during the performance technique is carried out in the MATLAB programming. At this juncture, the required constraints encompass X and Y value and velocity of X and Y. With the

**Table 3.** Predicted top gestures for different algorithm

		Inpu	Outputs					
X coordinate values		Y coordinate values				Velocity		
$X_{1}$	$X_2$	Y <sub>1</sub>	Y <sub>2</sub>	X	Y	Lion	GA	DE
-1	-1	-1	-0.25	200	2200	Bottom	Bottom	left
-1	-1	-1	-0.25	200	4200	Right	Right	left
-1	-1	-1	-0.25	4200	4200	Тор	Тор	left
-1	-1	-1	-0.25	4200	6200	Тор	Тор	Тор
-1	-1	-1	-0.25	4200	8200	Тор	Bottom	Тор
-1	-1	-1	-0.25	6200	4200	Тор	Right	Right
-1	-1	-1	-0.25	6200	6200	Тор	Тор	Тор
-1	-1	-1	-0.25	6200	8200	Тор	Тор	Bottom
-1	-1	-1	-0.25	8200	6200	Тор	Тор	Тор
-1	-1	-1	-0.25	8200	8200	Тор	Right	left

Table 4. Predicted bottom gesture for different algorithm

		Inpu	Outroots						
X coordin	ate values	ues Y coordinate val		te values Velocity		Outputs			
$X_{1}$	$X_2$	Y <sub>1</sub>	$Y_2$	X	Y	Lion	GA	DE	
-1	-1	-0.25	-1	200	4200	Bottom	Right	Bottom	
-1	-1	-0.25	-1	2200	2200	left	left	left	
-1	-1	-0.25	-1	2200	4200	Bottom	Bottom	Bottom	
-1	-1	-0.25	-1	2200	6200	Bottom	Bottom	Bottom	
-1	-1	-0.25	-1	4200	2200	Bottom	Right	left	
-1	-1	0.5	-0.25	4200	4200	Тор	Тор	Тор	
-1	-1	0.5	-0.25	6200	8200	Тор	Right	Тор	
-1	-1	-0.25	-1	6200	6200	Bottom	Bottom	Bottom	
-1	-1	-0.25	-1	6200	8200	Bottom	Bottom	Bottom	
-1	-1	-0.25	-1	8200	2200	Bottom	Bottom	left	

 Table 5.
 Predicted left gesture for different algorithm

		Outroots						
X coordinate values		Y coordinate values		Velocity		Outputs		
$X_{1}$	$X_2$	$Y_{1}$	$Y_2$	X	Y	Lion		DE
-1	-0.25	-1	-1	4200	2200	Left	Left	Bottom
-1	-0.25	-1	-1	4200	8200	Left	Left	Left
-1	-0.25	-1	-1	6200	6200	Left	Left	Left
-1	-0.25	-1	-1	8200	200	Bottom	Тор	Bottom
-1	-0.25	-1	-1	8200	2200	Left	Left	Left
-1	-0.25	-1	0.5	4200	200	Left	Left	Left
-1	-0.25	-1	0.5	4200	6200	Тор	Тор	'Тор
-1	-0.25	-1	0.5	6200	200	Left	Bottom	Left
-1	-0.25	-1	-0.25	8200	200	Left	Left	Left
-1	-0.25	-1	0.5	6200	6200	Bottom	Left	Bottom

		Outmute						
X coordin	ate values	Y coordin	ate values	Velocity		Outputs		
$X_1$	$X_2$	$Y_1$	$Y_2$	X Y		Lion	GA	DE
-0.25	-1	-0.25	-1	6200	2200	Right	Right	Тор
-0.25	-1	-0.25	-1	8200	200	Right	Right	Right
-0.25	-1	-0.25	-1	8200	4200	Right	Right	Right
-0.25	-1	-0.25	-0.25	8200	4200	Тор	Left	Right
-0.25	-1	-0.25	0.5	6200	6200	Right	Right	Right
-0.25	-1	0.5	-1	8200	2200	Right	Right	Right
-0.25	-1	0.5	-0.25	4200	200	Right	Left	Left
0.5	-1	-1	-1	6200	6200	Bottom	Bottom	Bottom
0.5	-1	-1	-0.25	6200	8200	Right	Тор	Right
0.5	-1	-1	0.5	4200	200	Right	Right	Left

Table 6. Predicted right gesture for different algorithm

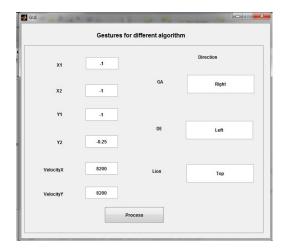


Figure 6. Matlab output.

input based on several techniques the gestures are identified. For various testing data values, the outputs are achieved in several methods. Table 2 contains last data input values, whereas the matching output values are indicated in Figure 6. In this process the input data based gesture in LA are producing 87.23% of the GA and DE technique. With this GUI derived approach, the input values are changed and the corresponding output the gestures are evaluated.

# 3.4 Statistical Measures of Gestures for **Different Algorithm**

Different gestures are considered for the LA, DE, and GA process to predict the gesture. The parameters such as TP, TN, FP and FN are obtained and based on these values certain statistical measures of each gestures for each algorithm.

In Table 7 shows that the different gestures evaluate the TP, TN, FP, and FN from these attains the result such as the sensitivity, specificity, accuracy values as per the below-mentioned formulas. In this process top gesture for the LA attain the 85% accuracy and the sensitivity of LA compared to the GAand DE the difference is 45% and the TP value 8 so only the high accuracy attained. Then the TN is 26 so the sensitivity attained in 80%. Bottom gesture the accuracy of the LA is 82.5, the sensitivity of GA and DE the difference is 20%, and specificity is 3.35%. Similarly the left and right gestures the accuracy 92% attained in LA algorithm.

Formulas used for finding Table 7

$$Sensitivity = \frac{Number\ of\ True\ Positives}{Number\ of\ True\ Positives\ +\ Number\ of\ False\ Negatives} \tag{7}$$

$$Specificity = \frac{Number\ of\ True\ Negatives}{Number\ of\ True\ Negatives\ +\ Number\ of\ False\ Positives} \tag{8}$$

$$Accuracy = \frac{(TP + TN)}{TP + TN + FP + FN} \times 100$$
 (9)

# 3.5 Binary Classification

A ROC curve represents a graphical plot that demonstrates the accomplishment and efficiency of binary classifier system as its discrimination threshold is altered. The curve is generated by plotting the true positive rate against the false positive rate at various threshold settings. The ROC is otherwise called a relative operating characteristic curve, as involves an analysis and contrast of two diverse operating characteristics such as TPR and FPR in accordance with the alteration in the benchmark.

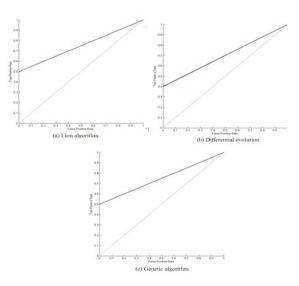
Gesture	Algorithm	TP	TN	FP	FN	Sensitivity	Specificity	Accuracy
Тор	LA	8	26	4	2	80	86.6667	85
	GA	5	26	4	5	50	86.6667	77.5
	DE	4	26	4	6	40	86.6667	75
Bottom	LA	7	26	4	3	70	86.6667	82.5
	GA	5	26	4	5	50	86.667	77.5
	DE	5	25	4	5	50	83.3333	75
	LA	7	30	0	3	70	100	92.5
Left	GA	7	29	1	3	70	96.6667	90
	DE	6	30	0	4	60	100	90
Right	LA	8	29	1	2	80	96.6667	92.5
	GA	6	24	6	4	60	80	75
	DF	6	29	1	4	60	96 6667	87.5

Table 7. Statistical measures of gestures for different algorithm

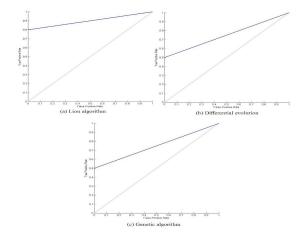
In a ROC curve, the true positive rate (Sensitivity) is plotted in the Y axis is plotted as a function of the false positive rate (Specificity) plotted on the X axis for diverse cut-off points of a constraint. This graph elegantly exhibits the vital device for diagnostic test analysis. The true positive rate is plotted as a function of false positive rate for various cut off points of a constraint. Each point on the ROC curve represents a sensitivity/specificity pair in terms of the specific decision threshold. The "steepness" of ROC curves is also very pertinent; as it is preferable to maximize the true positive rate while reducing the false positive rate. ROC curves are characteristically employed in binary categorize to assess the output. Figure 7 shows that the ROC curves of the top gesture for different algorithm such as LA, GA, and DE. The top left corner of the plot is the "ideal" point characterizing a false positive rate of zero, and a true positive rate of one. Top gesture the true positive rate value of the LA is 0.8 it's a perfect curve compared to the DE and GA techniques.

In Figure 8 shows that the ROC curves of the bottom gesture and the LA have an ideal point of this gesture. The TPR of LA compared to other technique 0.4 is varied 0.8 is attained in LA technique and 82% perfectly predict the bottom gesture.

In Figure 9 shows that the ROC curves of the left gesture and the LA have an ideal point of this gesture. The TPR of LA compared to other technique 92.5% classifies the left gesture. It is possible to draw one ROC curve per label, thought a ROC curve can be drawn by taking into account each element of the label indicator matrix as a binary prediction.



**Figure 7.** ROC curves for top gestures.



**Figure 8.** ROC curves for bottom gestures.

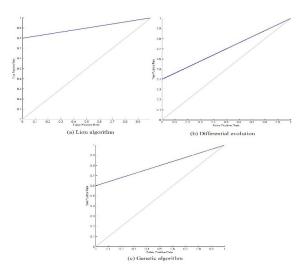


Figure 9. ROC curves for left gestures.

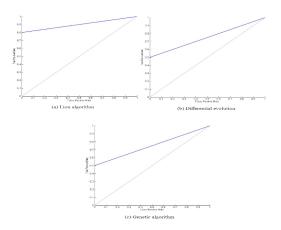


Figure 10. ROC curves for right getures.

Figure 6 shows that the ROC curves of the right gesture for different algorithm such as LA, GA, and DE. The top left curve of the plot is the "ideal" point differentiates a false positive rate of zero, and a true positive rate of one. Right gesture the true positive rate value of the LA is 0.8 it's a perfect curve compared to the DE and GA techniques.

# 4. Conclusion

This paper explains the ANN for Braille coded gesture patterns and the optimization strategies were applied. The Lion algorithm amazingly attains the accurate ideal values of the weights in the model. Multivariable optimization issues, conduct in the universal optimum solution and illustrates the adaptability to choose the design variables based on the weights. During the operation of the system the different gestures such as left, right, top and bottom are assessed with the data sets. The convincing output results are observed to be nearly equal to the data set minimum error value of gestures achieved in the LA optimization method. In each gesture of the ANN with LA is performed and the results are shown in above. In the future, the ANN researchers will look towards further incredible improvement methodologies for the harvests of diminished errors with their sterling techniques and identify the gestures for the blind people.

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