Hand Gestures for alphabets	Total Testing Images of True Positive classes	Evaluation Rate of SVM in %	Evaluation Rate of HMM in %	Evaluation Rate of CNN in %	Evaluation Rate of NF in %
A	10	100%	90%	100%	100%
B	10	100%	80%	100%	100%
C	10	90%	80%	90%	100%
D	10	100%	100%	100%	100%
E	10	100%	70%	100%	100%
F	10	90%	90%	80%	100%
G	10	90%	50%	90%	100%
H	10	90%	50%	100%	100%
I	10	80%	40%	90%	90%
J	10	100%	50%	100%	100%
Total	**100**	**94%**	**70%**	**95%**	**97%**

Table 2. Evaluation Results of SVM, HMM, CNN & NF algorithm

Following is the graphical representation of evaluation result.

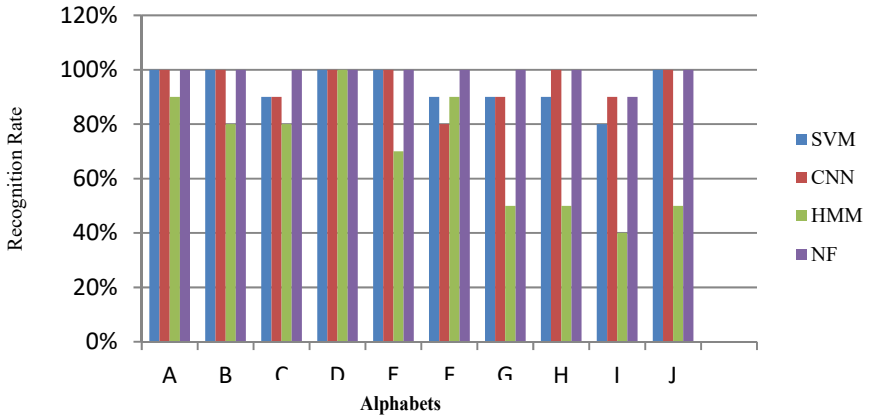

Fig 5. Recognition rates obtained by testing each method on sequences of gestures images alphabets A to J

5. Comparison of SVM, CNN, HMM & NF

5.1. Comparison of SVM, CNN, HMM & NF Based On Different Performance Evaluation Parameters

Performance Evaluation Parameters	SVM	CNN	HMM	NF
Time Complexity	It take both long training time & testing time	It take long training time and less testing time	It take both long training time & testing time	It take both less training time & testing time
Space Complexity	It consumes less memory	It consumes less memory	It consumes more memory then NF	It consumes less memory then other algorithms
Sample Complexity	Don't need large amount of training data	Needs large amount of training data	Needs large amount of training data	Needs large amount of training data
Parametercity	Require more parameters to classify images	Require less parameters to classify images	Require more parameters to classify images	Require less parameters to classify images then other algorithms
Response time	It take long time to give first response	It take less time to give first response	It take long time to give first response	It take less time to give first response

Table 3. Comparison of existing algorithms and Proposed Algorithm

Performance Evaluation Parameters	SVM	CNN	HMM	NF
Training Time Complexity	2.5 Seconds	1.5 Seconds	2.0 Seconds	0.9 Seconds
Testing Time Complexity	1.39 ms	1.08 ms	1.20 ms	0.89 ms
Space Complexity	500 bytes	480 bytes	490 bytes	445 bytes
Response time	1.05 ms	0.90 ms	1.15 ms	0.78 ms
Accuracy based on confusion matrix	93%	70%	92%	96%

Table 4. Comparison of existing algorithms and Proposed Algorithm based on evaluated values of different parameter

Confusion matrix

A confusion matrix is use to find the performance of classification model where matrix is evaluate by true positive and false positive class. To get more accuracy model has been evaluate by counting Precision, Recall & F-score. For the testing purpose we have taken 10 positive classes and 10 negative classes of each sign. Each class consists of 10 images of each sign respectively.

5.2 Advantages of Neuro-Fuzzy Approach Compare To SVM, CNN, HMM

5.2.1 Disadvantages of SVM, CNN, HMM

i. SVM doesn't perform well when we use large amount of data volume.
ii. CNN needs more feature symbols to evaluate optimal solution.
iii. CNN needs large amount of training data to find solution.
iv. HMM also requires large amount of training data.
v. HMM states require independent or annotated data volume of training set.

5.2.2 Advantages of Neuro-Fuzzy Approach

i.N-F consists merits of both individual algorithm neural network and fuzzy logic.
ii.N-F algorithm is described both self-learning and decision power.
iii.N-F faced fewer difficulties even though we use large amount of data volume.
iv.N-F needs less computational cost compare to other mention algorithms.

6. Conclusion

This paper conclude that Sign language recognition is the key feature since last few decades and very useful to the society as physically hearing-impaired or mute people can easily communicate in front of normal people. Recognition has been done using image processing and Classification. Classification has been performing on four algorithms: SVM, CNN, HMM and N-F which next describe the comparison among them in the form of evaluation results. On the base of evolution and comparison, conclusion is that, neuro-fuzzy network is the better classification algorithm for presented research-based system. N-F algorithms consist merits of both neural network and fuzzy logic makes it high computational algorithm compare to SVM, CNN, and HMM. We have achieved 94% accuracy with the use of SVM, 70% accuracy with the use of HMM, 95% accuracy with the use of CNN and 97% accuracy with the use of N-F algorithm. Paper describes a MATLAB editor which is used for implementation. Confusion matrix describe clear picture of accuracy of N-F approach compare to other algorithms.

7. Future Work

Though we have researched many things about sign language recognition, there are many techniques still apart from presented techniques for feature extraction as well as classification. One can also work on dynamic sign language recognition.

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