A COMPARATIVE ANALYSIS ON SIGN LANGUAGE PREDICTION USING MACHINE LEARNING ALGORITHMS

Proddutur Shruthi, Dr. Jitendra Jaiswal

Department of Computer Science and Engineering,
SET, Jain Deemed to be University, Jakkasandra, Kanakapura road, Bangalore, India.

Abstract : Sign language is a language which is mostly used between the deaf people to communicate among them. As there is a difference between them and us i.e. as we cannot understand what they say through sign language, to communicate with them we build a system called sign language recognition system. There are many classification algorithms present to detect the sign language but here we are going look forward only four algorithms which are KNN, random forests, K-means, SVM). This paper presents a comparative analysis of various machine learning algorithms for the American Sign Language dataset

Index Terms – Sign Language, KNN, SVM, K-Means, Random Forests.

I. INTRODUCTION

Sign Language is the essential methods for correspondence for those with hearing and vocal incapacities. Those impeded experience issues in their everyday lives. We plan to build up a framework that would facilitate this trouble in correspondence. Sign Language comprises of making shapes or developments with your hands as for the head or other body parts alongside certain facial prompts. An acknowledgment framework would therefore need to recognize explicitly the head and hand direction or developments, outward appearance and even body present.

American Sign Language was picked since it is used by a dominant part of those crippled [1]. World Health Organization's (WHO) overview states that above 6% of the total populace is experiencing hearing weakness. In March 2018, the quantity of individuals with this incapacity is 466 million, and it is relied upon to be 900 million by 2050.World wide there are so many people who are suffering from hearing and the speech impairment. They don't think these weaknesses as handicaps; it is another method of an alternate life. Be that as it may, their circle is a lot of restricted.

They ought not to be a piece of the hard of hearing world alone, which appears to be secluded now and again. Content informing, composing, utilizing visual media and finger spelling are a couple strategies used to build up correspondence between typical and hearing and discourse weakened individuals. Be that as it may, they favour gesture based communication simply because they can communicate their feelings and emotions through signs as it were. So talking in their provincial sign language carries more solace for the individuals to share their thoughts and musings among their close and dears.

II. BACKGROUND

Communications through signing are a visual portrayal of contemplations through hand motions, outward appearances, what's more, body developments. Sign Language likewise has a few variations, for example, American Sign Language (ASL), Argentinean Sign Language (LSA), and British Communication through signing (BSL) and ISL. The meeting and discourse hindered individuals lean toward the gesture based communication, which is for the most part utilized in their district. Readily, there is a strategy called Sign Language which is an excellent way to cause them to have the option to speak with others. Be that as it may, the issue isn't all people groups are comprehended or ready to learn about Sign Language. With this exploration, we trust we can construct a superior correspondence with hard of hearing people groups. Sign language is perplexing and jumpers. In any event, utilizing distinctive dataset of a similar technique could make a huge contrast of result. To communicate with them here we will first analyze which method or which algorithm gives us more accuracy so that we can build a best model for the sign language recognition.

III. SIGN LANGUAGE RECOGNITION OF ALPHABETS, WORDS AND SENTENCES

In the above figure, it is the representation of the alphabets of American Sign Language which consists of only one handed. Alphabets A,B,C,D,E,F,G,H,I,J,K,L.M,N,O,P,Q,R,S,T,U,V,W,X, Y,Z, all are described with single hand only, where as in other sign language some of the alphabets can be shown with double hand notation. For example in ASL ie., Indian Sign Language the letters like A, B, D, E, F, G, H, K, M, N, P, Q, R, S, T, X, Y, Z uses two hand notation.

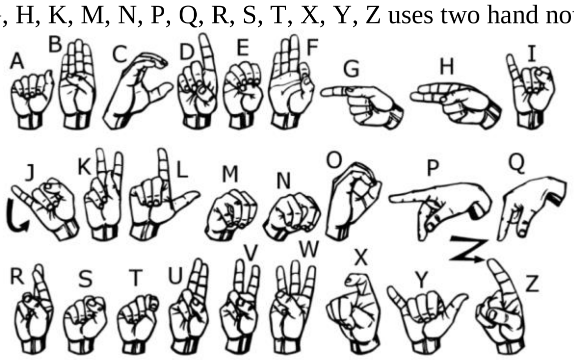

Fig 1. Alphabetical representation of American Sign Language

Figure 2: Representation of some words in sign language

As you see in the figure 2 there are some expressions which use the face expressions also so not only the hand movement but also face recognition should be done while the word or sentence is being expressed. After the completion of the sentence it should be the hand and face notation should be converted in the form of text.

IV. SYSTEM DESIGN

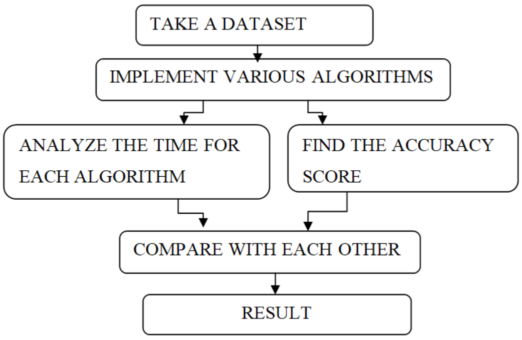

Fig3. System model

In this the various algorithms that we are considering is K-means, Random Forest, SVM and KNN.

4.1. Support vector machine

SVM is a controlled learning technique. It was invented by Vapnik [10]. In this method, each data thing is addressed as a point in a n-dimensional space with the estimation of every component being the estimation of a particular co-ordinate. The order is then performed by finding the hyper plane that separates the two classes well indeed. SVM builds up a hyper plane which has the greatest partition to the nearest getting ready data motivations behind any class, since when in doubt the bigger the edge, the lower the speculation blunder of the classifier[10].

The goal of SVM is to make a model which predicts the class name of data cases in the testing set adequately. It uses reinforce vectors (SVs) part to depict data from information space to a high-dimensional component space which urges the issue to be taken care of in straight shape and to discover a hyper plane in a N-dimensional space(N — the quantity of highlights) that particularly characterizes the information focuses. To isolate the two classes of information focuses, there are numerous conceivable hyper planes that could be picked.

Our goal is to locate a plane that has the most extreme edge, i.e. the greatest separation between information purposes of the two classes. Amplifying the edge separation gives some fortification so future information focuses can be ordered with more certainty. Hyper planes are choice limits that help characterize the information focuses. Information focuses falling on either side of the hyper plane can be credited to various classes. Additionally, the element of the hyper plane relies on the quantity of highlights [11]. On the off chance that the quantity of information highlights is 2, at that point the hyper plane is only a line. In the event that the quantity of information highlights is 3, at that point the hyper plane turns into a two-dimensional plane. It gets hard to envision when the quantity of highlights surpasses 3.

4.2 K-Nearest Neighbor

The k-closest neighbors (KNN) calculation is a basic, simple to-execute regulated AI calculation that can be utilized to take care of both characterization and relapse issues. A regulated AI calculation (instead of an unaided AI calculation) is one that depends on marked info information to get familiar with a capacity that delivers a proper yield when given new unlabeled information.

Envision a PC is a youngster, we are its administrator (for example parent, gatekeeper, or instructor), and we need the kid (PC) to realize what a pig resembles. We will show the kid a few distinct pictures, some of which are cows and the rest could be pictures of anything (felines, hounds, and so forth).

At the point when we see a cow, we yell "cow!" When it is anything but a pig, we yell "actually no, not cow!" After doing this multiple times with the kid, we show them an image and ask "cow?" and they will effectively (more often than not) state "cow!" or "actually no, not cow!" contingent upon what the image is. That is managed AI.

K-closest neighbor characterization was created from the need to perform discriminant examination when dependable parametric assessments of likelihood densities are obscure or hard to decide. In an unpublished US Air Force School of Aviation Medicine report in 1951, Fix and Hodges presented a non-parametric strategy for design grouping that has since become known the k-closest neighbor rule (Fix and Hodges, 1951). Later in 1967, a portion of the conventional properties of the k-closest neighbor rule were turned out to be; for example it was demonstrated that for k=1 and $n \to \infty$ the k-closest neighbor grouping mistake is limited above by double the Bayes blunder rate (Cover and Hart, 1967).

The K-nearest neighbors (KNN) algorithms are supervised type of machine learning algorithms which are extremely easy to implement and can perform quite complex classification tasks as well. All data is used for training while classifying a new data instance. It doesn't assume anything about the underlying data that is why it is non parametric algorithm used for classification and regression. Implementation of KNN Algorithm in Python follows the steps like handling the data, Calculate the distance, Find k nearest point, predict the class, and Check the accuracy.

KNN Algorithm:

1. Burden the information
2. Introduce K to your picked number of neighbors
3. For every model in the information
    3.1 Calculate the separation between the question model and the present model from the information.
    3.2 Add the separation and the record of the guide to an arranged assortment
4. Sort the arranged assortment of separations and lists from littlest to biggest (in climbing request) by the separations
5. Pick the primary K sections from the arranged assortment
6. Get the marks of the chose K passages
7. On the off chance that relapses, return the mean of the K labels
8. On the off chance that order, return the method of the K labels

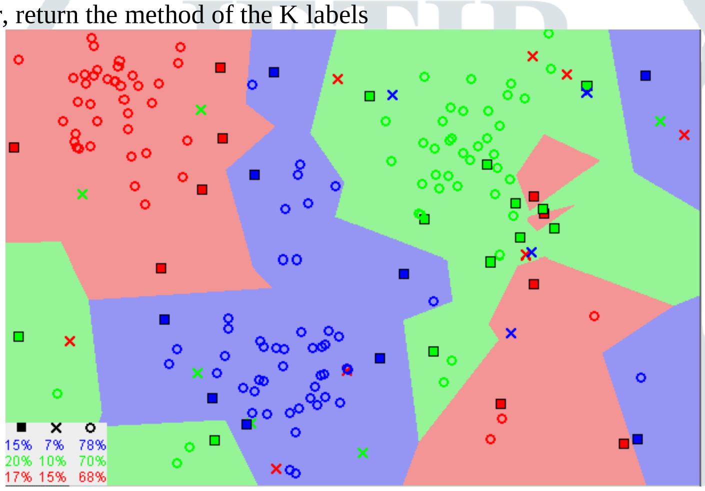

Fig4. Image showing how similar data points typically exist close to each other

3.3 Random Forest

We accept that the client thinks about the development of single order trees. Irregular Forests develops numerous characterization trees. To characterize another article from an info vector, put the information vector down every one of the trees in the woodland. Each tree gives a characterization, and we state the tree "votes" for that class. The timberland picks the arrangement having the most votes (over all the trees in the woodland).

Each tree is developed as follows:

On the off chance that the quantity of cases in the preparation set is N, test N cases indiscriminately - however with substitution, from the first information. This example will be the preparation set for developing the tree.

On the off chance that there are M input factors, a number m<<M is indicated with the end goal that at every hub, m factors are chosen aimlessly out of the M and the best split on these m is utilized to part the hub. The estimation of m is held consistent during the backwoods developing.

Features of Random Forests

- It is unexcelled in precision among current calculations.
- It runs effectively on huge information bases.
- It can deal with a huge number of information factors without variable erasure.
- It gives assessments of what factors are significant in the grouping.
- It produces an inside impartial gauge of the speculation blunder as the backwoods building advances.
- It has a powerful technique for assessing missing information and keeps up exactness when an enormous extent of the information is absent.
- It has techniques for adjusting mistake in class populace unequal informational collections.
- Produced backwoods can be put something aside for later use on other information.

- Models are figured that give data about the connection between the factors and the characterization.
- It figures vicinities between sets of cases that can be utilized in bunching, finding anomalies or (by scaling) give fascinating perspectives on the information.
- The capacities of the above can be reached out to unlabeled information, prompting unaided bunching, information perspectives and anomaly location.
- It offers an exploratory technique for distinguishing variable communications.

How Random forest works?

To comprehend and utilize the different choices, additional data about how they are figured is helpful. The vast majority of the alternatives rely upon two information objects produced by arbitrary backwoods. At the point when the preparation set for the present tree is drawn by inspecting with substitution, around 33% of the cases are kept separate from the example. This oob (out-of-pack) information is utilized to get a running impartial gauge of the grouping mistake as trees are added to the woodland. It is likewise used to get appraisals of variable significance.

After each tree is fabricated, the entirety of the information is run down the tree, and vicinities are registered for each pair of cases. In the event that two cases possess a similar terminal hub, their nearness is expanded by one. Toward the finish of the run, the vicinities are standardized by separating by the quantity of trees. Vicinities are utilized in supplanting missing information, finding anomalies, and creating enlightening low-dimensional perspectives on the information.

3.4 K-Means

Kmeans calculation is an iterative calculation that attempts to segment the dataset into Kpre-characterized unmistakable non-covering subgroups (bunches) where every datum point has a place with just one gathering. It attempts to make the intra-group information focuses as comparative as could reasonably be expected while additionally keeping the bunches as various (far) as could be expected under the circumstances. It appoints information focuses to a bunch with the end goal that the whole of the squared separation between the information focuses and the group's centroid (number-crunching mean of the considerable number of information focuses that have a place with that group) is at the base. The less variety we have inside groups, the more homogeneous (comparable) the information focuses are inside a similar bunch.

The way kmeans calculation works is as per the following:

- Indicate number of bunches K.
- Instate centroid by first rearranging the dataset and afterward arbitrarily choosing K information focuses for the centroid without substitution.
- Continue repeating until there is no change to the centroid. i.e. task of information focuses to groups isn't evolving.
- Register the entirety of the squared separation between information focuses and all centroid.
- Dole out every datum point to the nearest group (centroid).
- Register the centroid for the bunches by taking the normal of the all information focuses that have a place with each group.

Applications:

Kmeans calculation is well known and utilized in an assortment of utilizations, for example, advertise division, archive grouping, picture division and picture pressure, and so forth. The objective ordinarily when we experience a bunch investigation is either:

- Get a significant instinct of the structure of the information we're managing.
- Group then-foresee where various models will be worked for various subgroups on the off chance that we accept there is a wide variety in the practices of various subgroups. A case of that is grouping patients into various subgroups and manufacture a model for every subgroup to anticipate the likelihood of the danger of having coronary episode.

V. ENVIRONMENT SPECIFICATIONS

The device which based on it, the analysis and evaluation of various algorithms has the following specification (as in the table below)

Processor	Intel(R) Core(TM) i7-7500U CPU @2.70GHz
Installed Memory	8.00GB
System Model	64-bit operating system, x64-based processor
Os Name	Microsoft Windows 10

IV. RESULTS AND DISCUSSION

Algorithm	Accuracy
Support Vector Machine	84%
KNN	60%
Random Forest	79.9%
K-Means	47%

4.1 Results of Descriptive Statics of Study Variables

The above table discuss that the support vector machine gives an accuracy of 84% and the f1 score of this algorithm is 84% and this results comes if we import sklearn into our code. In KNN the accuracy we get is 60% and the f1 score is 60.7%. Then the random forest, in that the accuracy is 79.9%. In K-means we have 4 algorithms which is Hartigan–Wong, Forgy, Lloyds, MacQueen algorithms. So the accuracy of Hartigan–Wong is 47.74208 % and the time taken to execute is 8.819543 mins. The accuracy of Forgy is 47.62959 %.The time taken to execute is 31.18292 mins. The accuracy of Lloyd is 47.6364%.The time taken to execute 32.30492 mins. And last algorithm is MacQueen and the accuracy of that algorithm is 47.75613 %. The time take for MacQueen algorithm to execute is 8.73412 mins.

Figures and Tables

	labels	actual	predicted_hwong	predicted_Lloyd	predicted_Forgy	predicted_MacQueen
1	0	1126	585	834	1872	743
2	1	1010	1693	1052	2260	280
3	2	1144	1823	743	1283	1244
4	3	1196	1737	742	1844	885
5	4	957	647	1650	2295	2069
6	5	1204	1862	1742	1369	831
7	6	1090	252	1919	1242	1793
8	7	1013	1230	409	707	1753
9	8	1162	566	1443	930	772
10	10	1114	901	550	585	1174
11	11	1241	1957	907	1821	1488
12	12	1055	1559	1614	819	1609
13	13	1151	888	1133	472	538
14	14	1196	763	1939	1463	805
15	15	1088	1979	798	396	821
16	16	1279	1249	1376	880	1345
17	17	1294	856	1769	738	1298
18	18	1199	390	875	764	730
19	19	1186	765	1445	568	1101

Fig5. Kmeans actual Vs predicted results

V. ACKNOWLEDGMENT

I would like to express my sincere gratitude to the faculty members in the Department of Computer Science and Engineering (Data Science Specialization), JAIN deemed to be university, for their support and helping.

I am grateful to my supervisors Assistant Professor Dr. Jitendra Jaiswal Department of Computer Science and Engineering (Data Science Specialization) for his continuous guidance advice effort and invertible suggestion throughout the research. Without his help the project couldn't have been completed.

I am also grateful to Dr. V. Hari Kiran, Department of Computer Science Engineering, faculty of Computer Engineering, Koneru Lakshmiah University for inspiring me to work in this field.

I would also like to thank my friends of Data Science specialization batch 2019-2021 and my friends M. Bhavana, Ananaya bhavana DS, K Sindhura for motivating me and creating an atmosphere of competition.

REFERENCES

[1]. P.K. Bora M.K. Bhuyan and D. Ghosh. Trajectory guided recognition of hand gestures having only global motions. International Science Index, 2008.

[2] Amandeep Singh Dhanjal and Williamjeet Singh "Comparative Analysis of Sign Language Notation Systems for Indian Sign Language" 2019 Second International Conference on Advanced Computational and Communication Paradigms (ICACCP)

[3] Anup Kumar, Karun Thankachan and Mevin M. Dominic "Sign Language Recognition" 3rd InCI Conf. on Recent Advances in Information Technology I RAIT-20161

[4] , Herman Gunawan, Narada Thiracitta, Ariadi Nugroho "Sign Language Recognition Using Modified Convolutional Neural Network Model" The 1st 2018 INAPR International Conference, 7 Sept 2018, Jakarta, Indonesia.

[5] Miss. Juhi Ekbote and Mrs. Mahasweta Joshi "Indian Sign Language Recognition Using ANN and SVM Classifiers" 2017 International Conference on Innovations in information Embedded and Communication Systems (ICIIECS).

[6] Muthu Mariappan H and Dr Gomathi V "Real-Time Recognition of Indian Sign Language" Second International Conference on Computational Intelligence in Data Science (ICCIDS-2019)

[7] Swati Sharma, Varun Prakash Saxena, Kandukuru Satish "Comparative Analysis On Sign Language Recognition System" INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 8, ISSUE 08, AUGUST 2019 I

[8] Mrs.Dipali Rojasara and Dr.Nehal G Chitaliya "Indian Sign Language Recognition –A Survey" had written a review of hand gesture recognition methods for sign language recognition are discussed with different tools and algorithms applied on Indian sign language recognition system, along with challenges & future research direction and focuses on different techniques used for recognition of Indian Sign language.

[9] Shivashankara S, Srinath S "American Sign Language Video Hand Gestures Recognition using Deep Neural Networks" International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249-8958, Volume-8 Issue-5, June 2019.

[10] L. Fei, W. Yajie, Q. Hongkun and W. Linlin, "Gender Identification Using SVM Based on Human Face Images," Virtual Reality and Visualization (ICVRV), 2014 International Conference on, Shenyang, 2014, pp. 444-448.

[11] L. Yun, Z. Peng, "An Automatic Hand Gesture Recognition System based on viola-Jones Method and SVMs", International workshop on Computer Science and Engineering, IEEE Computer Society,2009,pp.72-76.