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Brain Stroke Detection using K-Nearest Neighbor and Minimum Mean Distance Technique

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Abstract- **This work aims to evaluate the relative performance of K-Nearest Neighbor Classifier and Minimum Mean Distance classifier of the brain stroke images. And it is a fully automated method to identify and classify an irregularity (hemorrhage) of stroke in brain. Whenever blood supply to the brain is stopped brain stroke occurs. Automatic detection and classification of MRI images brain stroke and non-stroke categories is complex phenomenon requires high level processing. In this paper the authors have proposed novel algorithm employing LabVIEW software and estimated the Identification score and Classification score and also the stroke area. Identification score for KNN method is greater than the Minimum mean distance. Both in KNN and MMD Maximum metric provides the high identification score than the Euclidian and Sum (Manhattan metric).**

Keywords- Brain stroke, Stroke Classification score, Identification score, stroke area, LabVIEW.

I. INTRODUCTION

A. Stroke

Non enhanced computerized tomography (CT) exams were used to detect the acute brain stroke by hypo dense symptoms (mostly affected area) notification. [1] which results in Severe disabilities are occur by brain Stroke and it is a disease which affects vessels that supply blood to the brain caused due to ruptures or block of vessels that supply blood to brain. [2,3]. Nerve cells in the damaged brain area support capable to make brain activities because of the absence of oxygen [4]. Stroke consequences result in severe long term frailty or death because the damaged area of the brain cannot function [5].

Brain stroke is mainly classified into two categories:

1. Hemorrhage Stroke**.**
2. Ischemic Stroke
3. Transient ischemic attack (a warning or "mini-stroke").

1.Hemorrhagic Stroke

A hemorrhagic stroke occurs when an artery in the brain leaks blood or ruptures (breaks open). The leaked blood puts too much pressure on brain cells, which damages them. Infarct stroke means bleeding into or around the brain due to split of blood vessel high blood pressure and aneurysms balloon-like bulges in an artery that can stretch and burst cause a hemorrhagic stroke.

There are two types of hemorrhagic strokes. Intracerebral hemorrhage is the most common type of hemorrhagic stroke. It occurs when an artery in the brain bursts, flooding the surrounding tissue with blood. Subarachnoid hemorrhage is a less common type of hemorrhagic stroke. It refers to bleeding in the area between the brain and the thin tissues that cover it.

2. Ischemic Stroke

Most of the strokes (85%) are Infarct type strokes. In this type of stroke, the artery that deliveries oxygen-rich blood to the brain becomes blocked.

3.Transient Ischemic Attack (TIA)

A transient ischemic attack (TIA) is a mini-stroke. It is different from the major types of stroke because blood flow to the brain is blocked for only a short time usually not more than 5 minutes. More than a third of people who have a TIA finish up having a major stroke within 1 year if they don't obtain treatment, and 10%-15% will have a major stroke within 3 months of a TIA.

Identifying and taking medical treatment TIAs can decrease the risk of a main stroke. A brain scan image including hemorrhage region can be seen with a bright region inside it and has high contrast relative to its surrounds [2]. An ischemic (infarct) stroke appears as a dark region (hypo dense), with the contrast relative to its surround [6] presented ischemic stroke detection by fuzzy method.

II. K-Nearest Neighbor (kNN)

The procedure of extracting information from an image is defined as Image Classification. To perceive, identify and categorize the features of an object is the main aim of image classification in an image depending on the type of class[7], . The NN classification algorithm identifies the unknown object of a class in an image on the basis of nearest neighbor extended to the unknown classes form the trained classes [8].

NN technique is applied in KNN method in which k to specifies the number of Nearest neighbors to be measured to define a class of sample data point [6]. a color is categorized into a class based on a elective mechanism. The Classifier finds *K* nearest samples from all the classes. The unknown color sample is assigned to the class with the mainstream of the votes in the *K* nearest samples.

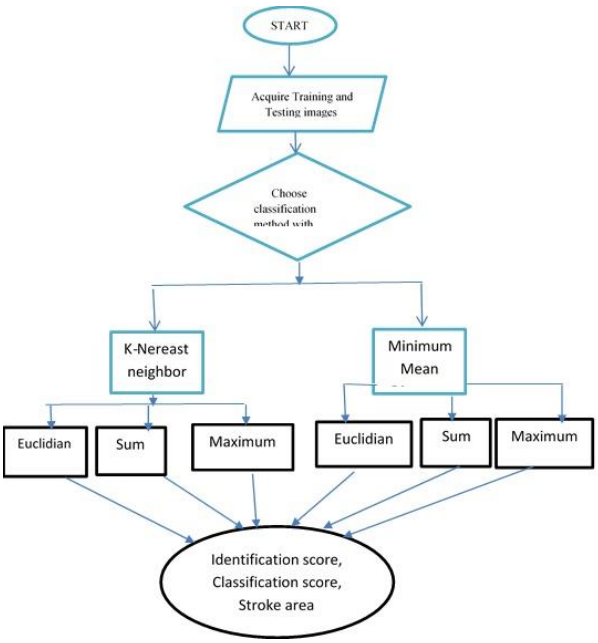


Fig.1. Flow chart of the proposed algorithm

The algorithm considers the input feature vector X of unknown class to a class C_j is determined as the
distance to the nearest neighbor is used to represent the class.

$$d(X,C_j)=\min d(X, X^j) \quad (1)$$

Where, $d(X, X^j)$ is the distance between X and X^j, the classification algorithm allots pattern X of unknown class to the class of its nearest neighbor that is given as

$$X \in \text{class } C_j, \text{ if } d(X, C_j) = {}^{\min}d(X, X^j) \quad (2)$$

In kNN algorithm the classifier finds the *k* nearest samples from all of the classes. With the majority of the chooses in the *k* nearest samples, the input feature vector X of the unknown class is allotted to the class Cj.

III. Minimum Mean Distance (MMD)

In minimum mean distance classification, an unknown color sample is classified based on its distance from each class cente [6] .

Consider that $\{X_{j1}, X_{j2}, X_{j3}.....X_{jn}\}$ be n_j feature vectors represent the class C_j. Every feature vector with a label of class j that has been selected for represents the class. The center of the class j is given

$$M_j = \frac{1}{n}\sum_{i=1}^{nj} X^j \quad (3)$$

An input feature vector X of unknown objects was classified in the classification segment depending on the distance to each class center and given

$$X \in \text{Class } C_j,$$

$$\text{If } d(X, M_j) = \min d(X,M_i) \quad (4)$$

Where, $d(X, M_j)$ is the distance function based on the distance metric chosen during the training phase.

A. Distance Metrics:

Three distance metrics for the classification methods are provided in the LabVIEW software, viz. these are Euclidean distance, Sum distance, and Maximum distance.

1. Maximum—Most sensitive to small variations between samples. Use Maximum when needed to classify samples with very small differences into different classes.

2. Sum—Metric used in most classification applications also known as the Manhattan metric or Taxicab metric. This is the default Metric value.

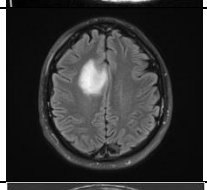
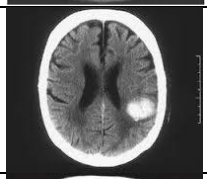
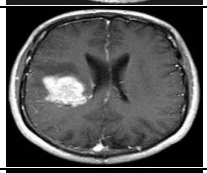
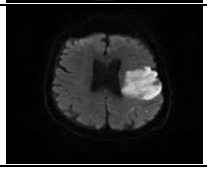
Sum distance

$$(L1) = D(a, b)=\sum_{i=1}^{n} |a_i - b_i| \quad (5)$$

3. Euclidean—Least sensitive to small variations between samples. Use Euclidean when needed to classify samples with small differences into the same class. $(a_i - b_i)^2$

$$d(a,b) = \sqrt{\sum_{i=1}^{n}(ai - bi)2} \quad (6)$$

TABLE.I-CLASSIFIER STATISTICAL MEASUREMENTS

Patients S.NO	Brain MR images	Area(Pixels)		Area(sq.mm)	
		KNN	MMD	KNN	MMD
1		254	240	67.20332	63.4992
2		1196	1233	316.43768	326.2271
3		1159	1213	306.64822	320.9355
4		729	729	192.87882	192.8788
5		309	292	81.75522	77.25736
6		220	220	58.2076	58.2076
7		1013	1029	268.01954	272.2528
8		798	759	211.13484	200.8162

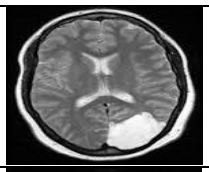
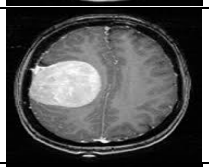
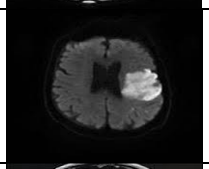
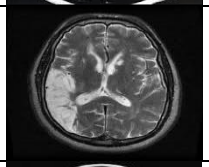
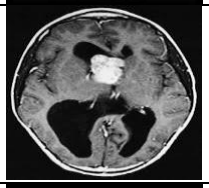
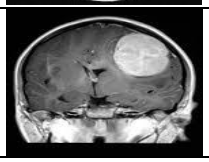
9		**934**	**934**	**247.11772**	**247.1177**
10		**3550**	**3644**	**939.259**	**964.1295**
11		**759**	**715**	**200.81622**	**189.1747**
12		**958**	**1035**	**253.46764**	**273.8403**
13		**2157**	**2129**	**570.69906**	**563.2908**
14		**677**	**702**	**179.12066**	**185.7352**
15		**1590**	**1543**	**420.6822**	**408.2469**

TABLE II - KNN WITH METRIC STATISTICAL VALUES

Patients	**KNN Classifier**					
	Metrics					
	MAX		**SUM**		**Euclidean**	
	Classification Score	**Identification Score**	**Classification Score**	**Identification Score**	**Classification Score**	**Identification Score**
1	1000	998	500	983	500	997
2	500	997	500	990	1000	997
3	500	997	1000	983	500	999
4	1000	998	500	991	500	997
5	500	994	1000	990	500	998
6	1000	974	500	986	1000	974

7	1000	978	500	990	1000	997
8	1000	994	385	986	1000	990
9	500	997	500	987	500	998
10	500	999	500	992	500	997
11	1000	994	500	989	1000	991
12	1000	869	500	989	1000	855
13	1000	995	500	992	1000	993
14	500	995	500	987	500	993
15	500	996	1000	988	500	995

TABLE III- MMD WITH METRIC STATISTICAL VALUES

Patients	**MMD Classifier**					
	Metrics					
	MAX		**SUM**		**Euclidean**	
	Classification score	**Identification Score**	**Classification score**	**Identification Score**	**Classification score**	**Identification Score**
1	169	989	383	982	223	988
2	280	996	309	988	370	995
3	276	996	548	982	46	993
4	202	996	117	978	24	992
5	315	996	355	987	76	992
6	844	939	306	984	821	894
7	295	995	203	986	329	993
8	529	994	67	985	382	987
9	155	995	66	979	219	994
10	426	995	168	986	589	997
11	749	997	473	993	623	993
12	591	870	60	988	603	795
13	543	993	207	998	624	992
14	216	995	470	995	63	990
15	27	994	496	982	233	993

IV. RESULTS AND DISCUSSION

The proposed algorithms are tested on 50 MR Images of different patients with respect to the brain stroke classification algorithms like K-Nearest neighbor and Minimum Mean Distance techniques. Classification score and Identification scores are calculated for both algorithms. The images used for analysis are eight bits per color channel. Images that we have used for testing contain brain strokes with different intensity, shape and size. In KNN and in Minimum Mean Distance methods identification for

different techniques like Euclidian, Sum, Maximum have been calculated. The identification score for KNN & MMD Methods are more than other two metrics.

V. CONCLUSION

Brain stroke detection is a complicated issue as it is similar to the brain tumor. Applying intelligent algorithms yields good results. The algorithms proposed in this paper are supervised and the distance measuring techniques are widely accepted. Both the algorithms gave good results against complexity but kNN is superior than MMD. The kNN method applied here with a fixed number of neighbors. Different supervised algorithms can also be included into this work.

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