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Feature based classification of Electrooculogram using SVM and KNN

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Abstract: In recent years, Electrooculography (EOG) is one of the technique to measure biomedical signal for analyzing the eye movement patterns in corneo-retinal which located between the front and back of the human eye. This electrographic signalused to measure the eye movements from left - right or top - bottom which creates the electrical deflections. In this paper, the EOG datasets was collected from five participants and before feature extraction the respective data are preprocessed which helps to reduce the dimensions of the given data. Then the features are extracted by SVM (Support Vector Machine), and KNN (K – Nearest Neighbor). Hence, the performance evaluation was proved that KNN gives 80.50% accuracy than SVM classifier.

Keywords: *Electrooculography, Corneo – Retinal, Support Vector Machine, K–NearestNeighbor*

I. INTRODUCTION

Electrooculography (EOG) is used to measuring the potential of corneo-retinal which exists in-between the front and back of the human eye. The Electrographic signal is measured by moving the eyes from left to right or up and down which create an electrical deflection. The set of three Ag/AgCl electrodes are placed in both sides of the eye to detect the movement from left to right [1].Then the voltage value are generated by the movement of eyes which are detected with the help of potential difference between the reference electrode and measuring electrode. A conducting gel is used to increase the relation between the skin and surface electrode which helps to reduce artifacts due to noise, then the adjustable bands are placed in the patient forehead and the central electrode are connected to the ground.On other hand, the left and right electrodes are connected to Vcc and its reference. For further processing the signalsare capturedwith the help of electrodes through EOG amplifier. The term angles of rotation of eyes are used to measure the movement of eye.

The main advantage of EOG is the techniques used for recording which is simple, cheap and done with lesser difficulty. The EOG readings are also measured even in the closed eye also it can be used to detect the aid of neurological disorder.It can be operated in modelingophthalmic instruments which have capable of identifying the variety of diseases. Further, this article discuss about the review then the data are collected form Biopac MP36R and these data are classified using both SVM and KNN classifier with 80.56%.

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II. LITERATURE REVIEW

Panos M.Pandalos et.al, proposes the amplification orientation of electric dipole for patient who affected neuro generative disease which can be measured by surface electrodes on the skin around the eyes then the severity of disease and abnormality of Arousal Ocular is clearly identified [2]. Rune Frandson et.al, test the neuro generative patientsto evaluate the potential of sleep using the approach of unsupervised learning. This can be concluded the amount of N3 and ability to maintain NREM & REM sleep have equal potential as PD biomarkers. Sue Lord,et.al [3], suggests the detection of Saccades within raw mobile EOG datasets. The EOG signal measured during static and dynamic task using wireless electrodes of EOG and an algorithm developed to detect saccades in EOG data.

Adas Gelzin et.al, suggestsrecording the signals from neuro generative patients disease through acoustic cardioid and smart phone electrodes. Thus the rate of performance was better in AC than SP microphones. Christensen, et.al [5], analyze normal as well as pathological patient sleep to identify the alteration in sleep pattern using EOG electrodes. It helps to identify sleep alteration within the peak detection, latency and variance. Erancisco Ferrero,et.al, 2019, proposed the software applications of bio potentials with acquired, processed and analyzed using EOG electrodes. It calculates the sensitivity, specificity and accuracy to indicate the proposed system viability as an affordable method for evaluation of disorders.

The electromagnetic peak detection are contributed by Albert F.Fuchs,et.al,torecord the Ocular movements and motor behaviors of motor disabilities patients who affected from Parkinson's disease [8]. A.C.Downing,et.al, analyze the eye movements of patients who affected by Parkinson's disease then the overall lagging time also concluded. K.A. Flowers et.al, examine the subjects which performed through sensory monitoring systems, muscle contractions, sensory monitoring systems, accuracy and oscilloscope. Finally, two kinds of patient's ability are analyzed with the help of movement disorder which make simple voluntary movements [11].

III. DATA COLLECTION

In this study, the EOG signal was collected from Biopac MP36R data processing unit. It consists of 5 subjects within the age 30 to45 and the sampling rate is adjust 80Hz for both channels as shown in below table 1.

Table. I Volunteer's Details

Subject	Age	Gender	Vision
1	30	Female	Normal
2	32	Male	Normal
3	35	Male	Glass
4	40	Female	Glass
5	45	Male	Glass

IV. CLASSIFICATIONS USING EOG SIGNALS

Support Vector Machine (SVM)

SVM is an efficient algorithm to classify distant objects among various fields such as text categorization [18], face recognition [19], and breast cancer [20]. It is a supervised algorithm which can be divided into two stages such as training and testing. In general, SVM take one set of input data and predicts each data for a given input which in the form of two classes of output that makes nonlinear probabilistic classifier. It has ability of grouping all distant classes into disjoints groups of classes. These grouping is used to train

a SVM classifier from the root node itself, also these samples are used as the first group as positive and the samples of the second group as negative samples.

K Nearest Neighbor (KNN)

KNN is a supervised method for classifying different objects based on the nearesttraining samples and it classifies the new data based on the similar values. These training dataare labelled and their classes can be specified. In the tested stage, unlabelled data are given asinput and the classifier generates the list of the k nearest data points to the testing point. It isone of the simplest classification algorithms where there is no need to distribution of data according tom the samples.

V. RESULTS AND DISCUSSION

In order to develop a network model, the respective datasets are classified as training samples which are selected randomly from the total samples of the given network and a neural network is trained. 60% of dataset has been used for training the neural network and the remaining 40% of dataset has been used to test the performances of the neural network.

No. of. Subjects	**Classification Accuracy using SVM Classifier (%)**				**Overall Accuracy (%)**
	Down	**Up**	**Left**	**Right**	
1	56	84	95	94	83.5
2	44	90	31	79	64
3	39	85	66	80	69
4	92	83	51	85	75.2
5	60	50	56	75	65
Mean	**59**	**81**	**57**	**84**	**75.5**

Table. I Result analysis of SVMusing EOG signals

No. of. Subjects	**Classification Accuracy using KNN Classifier (%)**				**Overall Accuracy (%)**
	Down	**Up**	**Left**	**Right**	
1	58	86	96	96	84.5
2	45	92	32	79	65.5
3	40	86	68	81	70
4	93	87	53	83	75.36
5	62	51	58	76	70
Mean	**60**	**82**	**60**	**85**	**80.56**

Table. II Result analysis of SVM using EOG signals

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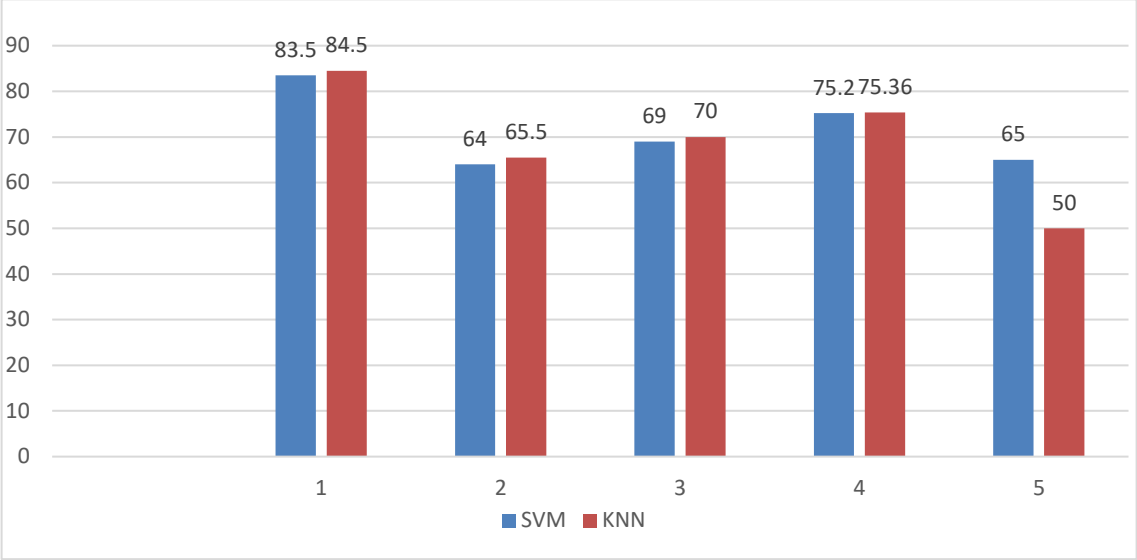

Fig. 1 Performance analysis of SVM and KNN Classifier using EOG Signals

From the Table 2& 3, it can be observed that overall accuracy with the help of 5 number of subjects using SVM and KNN Classifier. Further, the classification accuracy are done through the movement of eyes. In that, down represents the center-down-up move of eyes, up represents enter-up-down movement of eyes, left represents the eye movementfrom center - left - right and rightmovement denotesthe center-right-left. Therefore, these four classification techniques are analyzed using SVM and KNN classifier. Finally, it concluded that KNN gives 10% more accuracy than SVM classifier.

The performance analyses graph as shown in Fig.1. It observes the values of classification accuracy which obtained from the movement of eye ball in down, up, left and right with the feature of SVM and KNN classifiers.

VI. CONCLUSION

Electrooculography (EOG) is an efficient technique to identify the potential of corneo-retinal which located between the front and the back of the human eye. This Electrographic signal used to measured by moving the eyes from left to right or up and down which create an electrical deflection. The main objective of this paper to review the different approaches of EOG signal with the help of eye movementwhich can be examinedwith the help of SVM, and KNN Classifier. Therefore, it can be concluded that KNN gives 80.56% than SVM Algorithm.

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