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Analysis of Electrooculogram using SVM Classifier

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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 signal measure the eye movements from left to right or top to bottom which create the electrical deflections. In this paper, the EOG data was obtained from five participants and the respective data was preprocessed before feature extractions that help to reduce the data dimensions. These features are extracted by Support Vector Machine (SVM) and the performance evaluation was analyzed with classification accuracy of 70.50%.

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

I. INTRODUCTION

Electrooculography (EOG) is a technique to measure the corneo-retinal standing potential which exists between the front and the 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 the sides of the eye to detect the left and right movement [1].The value of the voltages generated by the eye movement are detected by the potential difference between a measuring electrode and a reference electrode. A gel conducting is used to enhance the contact between the surface electrode and skin which helps to reduce artifacts due to noise. Adjustable bands with electrodes conducting.Ground is connected by the central electrode. The term angles of rotation of eyes are used to measure the movement of eye.The EOG signal is used to study the related aspects and patternofthe eye movements.

The main advantage of EOG is the techniques used for recording are cheap and simple. The readings of the eye can be taken when the eye is closed the EOG can be measured also it can detect the neurological disorder of the patients.The block diagram of abased EOG standaloneHuman Computer Interface (HCI) system. Further,this article discuss about the review then the data are collected form Biopac MP36R and these data are classified using SVM algorithm.

II. LITERATURE REVIEW

PanosM.Pandalos et.al, proposes the amplification orientation of electric dipole for patient who affected neuro generative disease. The severity of disease and abnormality of Arousal Ocular is

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clearly identified [2]. Rune Frandson et.al, test the neuro generative patientsto evaluate the potential of sleep usingunsupervised learning approach and modeling. 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.

AdasGelzin 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. EranciscoFerrero,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,to record 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 tracking time lag for each condition was determined. K.A. Flowers et.al, examine the subjects which performed through sensory monitoring systems, muscle contractions, sensory monitoring systems, accuracy and oscilloscope [11].

Data Collection

In this study, the EOG signal was collected from Biopac MP36R data processing unit. It consists of 5 subjects within the age 26 and 32 and the sampling rate is adjust80Hz for both channels as shown in below table 1.

Table. I Volunteer's Details

Subject	Age	Gender	Vision
1	26	Male	Glass
2	28	Male	Normal
3	30	Female	Glass
4	31	Female	Glass
5	32	Male	Normal

Classifications using EOG Signals

Support Vector Machine (SVM)

SVM is highly efficient algorithm among various fields such as text categorization [18], face recognition [19], and breast cancer [20]. It is a supervised algorithm which has testing and training algorithm. It has ability grouping all classes. This grouping a SVM classifier of decision tree in the root node, using the samples of positive examples as the group one and the samples ofnegative examples as the group two.

III. RESULTS AND DISCUSSION

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. From the Table 2, it can be observed that overall accuracy with the help of 5 number of subjects using SVM algorithm. Further, classification accuracy aredone through the movement of eyes. In that,

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down represents the center-down-up move of eyes, up represents enter-up-down movement of eyes, left represents the event which eyes move from center-left-right and rightmovement represents the center-right-left. Therefore, these four classification techniques are analyzed using the SVM classifier.

Table. I Result analysis of SVM using EOG signals

No. of. Subjects	Classification Accuracy (%)				Overall Accuracy (%)
	Down	Up	Left	Right	
1	56	84	95	94	83.5
2	43	90	30	79	62.5
3	39	85	66	80	68
4	91	86	51	85	75.2
5	60	50	56	75	61
Mean	**59**	**80**	**58**	**84**	**70.50**

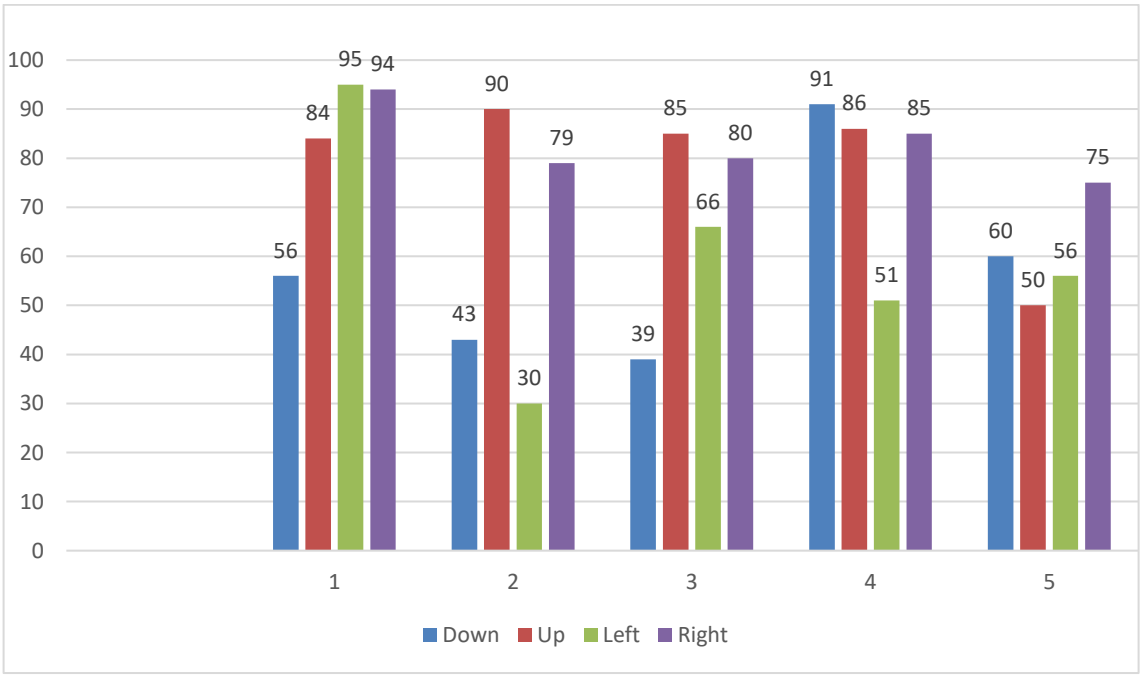

Fig. 1 Performance analysis of EOG signals using SVM Classifier

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 classifier.

IV. CONCLUSION

Electrooculography (EOG) to measure the standing potential of the corneo-retinal which exists between theback of the human eyeand front end 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 main objective of this paper to review the different approaches of EOG signal with the help of eye movementfor Parkinson's patients and voluntary movements are examinedinterms of accuracy, object detection and latency.

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