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Analysis of EMG Signals using Feed forward Neural Network

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Abstract: Electromyography (EMG) is one of the wide areas in the medical field, to analyze the biological signals for detecting the movements of muscles. The major studies based on to recorded electrical signal which helps to diagnose the conditions of muscle disorders. Further, EMG is used for prosthesis control, rehabilitation for clinical diagnosis and the electrical signals are generated to control and activate the myoelectric artificial prosthetic arm.However, this paper provides a comprehensive review on EMG signals with different datasets and experimental results are extracted from Feed forward Neural Network (FNN) for future approaches.

Keywords: *Electromyography, Feed forward Neural Network*

I. INTRODUCTION

Electromyography (EMG) is a device which is widely used to measure and record the electrical activity of muscles. This recorded electrical signal is called as an electromyogram which helps to diagnose the conditions of muscle disorders. The time duration testing of EMG testingis approximately 30 to 90 minutes that depends on the study of muscles. This leads to analyze the abnormalities of neuromuscular disease. However, EMG is used for prosthesis control, rehabilitation and also for clinical diagnosis [1]. The electrical signals are generated in EMG which helps to control and activate the myoelectric artificial prosthetic arm, and then the electrodes are placed in the arm muscles through the surface of the skin. The types of electrodes are surface electrode, needle electrode and fine wire electrode.The electrical activity of the muscle should concern the clinical examination in EMG and the clinical abnormalities of chronic denervationof a normal muscle are detected as shown in fig. 1[2].However, the main issues are concluded during the measurement of EMG signals:

- The intensity and timing of muscle contraction, which is to determine any segments of the muscles in the area of electrode is active.
- The placement of electrode from the measure muscles area and the electrode must be placed in the belly regions of muscles
- The designed properties of muscle and electrodes are combined with two types of electrodes which can be further divided into two categories they are invasive and non invasive electrodes [1].

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Besides, this paper represents the review of EMG signals which is based on different datasets then the overall components and methods are discussed for future approaches.

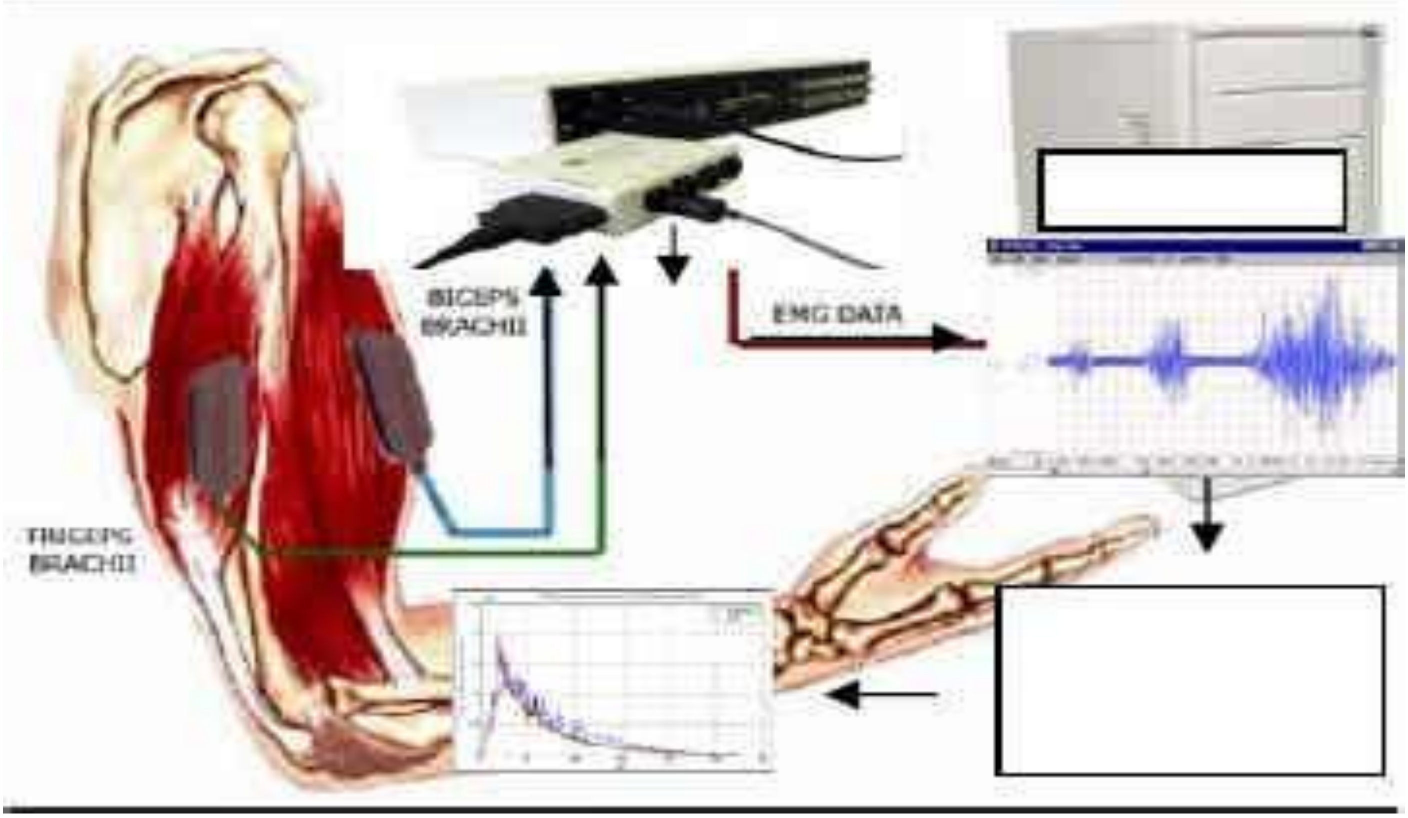

Fig.1 Block diagram of EMG Signal

II. REVIEW ON ELECTROMYOGRAM (EMG)

Joan Lobo-peter, peter N koorenet.al, suggests the EMG signal or force signals which are used as inputs for admittance based controller by using the samples of adult DMD patients (male). This design is used to analyze the interface, which is more suitable for control the wearable devices for activate the arm support [1]. Joan Lobo-prat, mariskajanssen, et.al, proposes the movements with force based control for three male adults with DMD in the age of (21-22 years). This study presents feasibility and performance evaluation of EMG signals [2]. For muscle detection, the ultrasound image acquisition was proposed to predetermine the force. Then, the features of input images are sieving through edge detection parameters over a training dataset and the system performance are extended by muscle groups [3]. Yinxue Wang, Luca Bello, YueWang,et.al, suggests the machine learning approaches topredict age at LoA based on clinical measures of muscular strength and motor function using CINRG dataset.It is a multivariate model topredict the age at LoA for DMD patients based onclinical outcomes [4]. Further, the inconspicuous and simple planar active arm used to support the adults with DMD which can be controlled within the force or EMG based interfaces [5]

Sathyavikasini K, Vijaya et.al, proposes mutated gene sequences of fifty five genes for disease identification, positional cloning, disease gene datasets, feature extraction and training dataset [6]. UvaisQidwai, AejazZahidet.al, suggests the detecting muscular movements from facial muscles especially eyebrow movement muscles using children with SMA datasets. This system is to enable the children to use computer system and other control systems [7].

Anne J. Pigula, Jim S. Wu et.al, contributes the ultrasound videos of muscle compression under known pressures in the biceps and quadriceps of 23 boys with DMD within 20 age-matched healthy controls, clinical data and demographics. It can be performed in a few minutes, and requires minimal action from the patient. Kostas Nizamis, Joan Lobo-Pratet.al, conducted the device in a 2-D horizontal tracing using EMG-based control interface to detect the user's movements [9]. Further, Global cardiac function and presence of fibrosis, but changes in these measures are late manifestations using the datasets of boys with DMD and associated with cardiomyopathies. It involves cardiac movement in DMD for improving patient careand aiding the evaluation of emerging therapies [10].

Lev R, Seliktar D, proposes the Cell delivery systems in muscle injuries and ailments, including their mild processing conditions. It uses the patients datasets includes muscular dystrophies and muscle injuries. Themuscular dystrophies is the therapeutic repair of muscle injuriesand muscle wasting diseases [11]. However the Software designed for use with the device computed several variables to qualify and quantify muscular activity in the non-ambulant subjects [12].

Further, the analyses are taken from different patients with genetic diseases. This problem is handled for non-synonymous single nucleotidevariants (SNVs) that capture only missense and nonsense mutations. Then the outcome of trained model reports that the prediction accuracy of86% in multi-class SVM with the RBFkernel [15].David Sala, Thomas J. cunninghamet.al, proposes boosting muscle stem cells to treat muscular dystrophy and aging muscles for patients with muscular dystrophy [16]. The Predicting muscular dystrophy with sequence based features for point mutation for patients affected with genetic diseases caused by the deformity in the inherited genes. The resultant shows the prediction accuracy of 100% by estimating using 10-fold cross validation [17].

III. CLASSIFICATION

Feed forward Neural Network (FNN)

In multilayer neural networks, the information processing takes place only in the fed forward path, i.e. through the input layer, the output layer and the hidden layer. A MFNN is said to be static neural network model because it is characterized by non-linear equations that are memory less. In general, a single neuron computes the weighted input values and obtains output values through a non-linear activation function with a threshold. The Feed-forward neural networks (FNN) are widely used for pattern classification, due to probability distribution (or) classify the distant regions. It is mainly used for accurate classification of input data into various classes were these are obtained by pretrained model. Generally, the FNN architecture consists of multilayer neural network for specific application as shown in the fig. 1.

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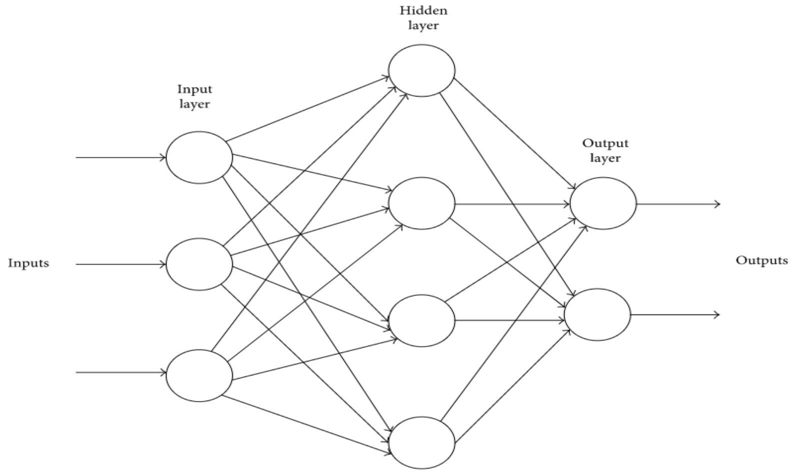

Fig. 2 Diagram of Feed forward Neural Network (FNN) [30]

Table.1 Classification results of Feed forward neural network

Parametric Feature	Accuracy (%)	Sensitivity (%)	Specificity (%)	F measure (%)
AR Pole Tracking with 10th order	87	89	88	85
AR Pole Tracking with 15th order	96	95	93	91
AR Pole Tracking with 20th order	95	93	94	93.5

The major property of FNN are assigned in three ways i) Network topology, ii) the training and iii) activation function of neuron. The network might have more layers of neurons and its architecture supported for a feed-forward network. Similarly, linear neurons are selected for the output layer. Finally, the configuration represents the input neurons, hidden layer, and it indicates the brain under AD.

IV. RESULT AND DISCUSSION

In order to develop a generalized neural network model, the training samples are randomly selected from the total samples 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.

From the Table 1, it can be observed that AR pole tracking with 15th order using MFNN reported the highest classification of MFNN has obtained specificity 96%, sensitivity 93% and F measure 90% when compared to 10th pole tracking.

V. CONCLUSION

Electromyography (EMG) is a device which is widely used to measure and record the electrical activity of muscles. This article represents the comprehensive review on EMG signals. It is based on different algorithms using real time datasets interms of bandwidth, efficiency and system performance. Finally, the results are taken from FFNN algorithm and various methods are discussed for future approaches.

REFERENCES

[1]. Abu Osman N.A, Ibrahim F, 'Electromyography Signal Based For Intelligent Prosthesis Design', Biomedical Proceedings, pp. 187 – 190, 2008
[2]. The basics of Electromyography – K R MILLS
[3]. Lobo Prat Joan, Frank, Kooren Peter, 'Design and Control of the A-Arm: an Active Planar Arm Support for Men with Duchenne Muscular Dystrophy', 2016.
[4]. Joan Lobo-Prat, Mariska M H P Janssen, 'Surface EMG signals in very late-stage of Duchenne muscular dystrophy: a case study', 2017.
[5]. Wachinger, Christian, 'The 2D analytic signal for envelope detection and feature extraction on ultrasound images', 2012.
[6]. Gang Wang,* Yanyan Zhang, and Jue Wang, 'The Analysis of Surface EMG Signals with the Wavelet-Based Correlation Dimension Method', 2014.
[7]. Straathof, Paul,Lobo-Prat, Joan, 'Design and Control of the A-Arm, an Active Planar Arm Support for Men with Duchenne Muscular Dystrophy',2016.
[8]. K Sathyavikasini, M S Vijaya, 'Predicting muscular dystrophy with sequence based features for point mutations',2015.
[9]. Tsui, Chun Sing,Jia, Pei, 'EMG-based Hands-Free Wheelchair Control with EOG Attention Shift Detection', Proceedings of IEEE International Conference on Robotics and Biomimetics,2008.
[10]. Anne J Pigula, Jim S Wu, 'Force-Controlled ultrasound to measure passive mechanical properties of muscle in Duchenne muscular dystrophy',38th Engineering in Medicine and Biology Society (EMBC), 'Annual International Conference of the IEEE',2016.
[11]. Nizamis , Kostas , Lobo Prat, Joan , ' Switching Proportional EMG Control of a 3D Endpoint Arm Support for People with Duchenne Muscular Dystrophy',2015.
[12]. Magrath P , Maforo N , 'Cardiac MRI biomarkers for Duchenne muscular dystrophy',2018.
[13]. Lev R ,Seliktar D , 'Hydrogel biomaterials and their therapeutic potential for muscle injuries and muscular dystrophies',2018.
[14]. Anne Gaelle Le Moing ,AndreeaMihaelaSeferian , A Movement Monitor Based on Magneto Inertial Sensors for Non Ambulant Patients with Duchenne Muscular Dystrophy: A Pilot Study in Controlled Environment', 2016.
[15]. Straathof, Paul, Lobo-Prat, Joan, ' Design and Control of the A-Arm, An Active Planar Arm Support for Men with Duchenne Muscular Dystrophy',2016.
[16]. P Hilton Brown , E Stalberg , 'Motor Unit Size in muscular dystrophy, A macro EMG and scanning EMG study', 1983.
[17]. K Sathyavikasini, M S Vijaya, 'Muscular Dystrophy Classification Using Relative Synonymous Codon Usage',2016.
[18]. David Sala, Thomas J Cunningham, 'The Stat3 Fam3a axis promotes muscle stem cell myogenic lineage progression by inducing mitochondrial respiration',2019.
[19]. K Sathyavikasini, M S Vijaya, 'Predicting muscular dystrophy with sequence based feature for point mutations',IEEEInternation Conference on Reasearch in Computational Intelligence and Communication Network(ICRCICN),2015.
[20]. Michele Lloyd Puryear , Jerry R Mendell, 'Report of MDA muscle disease

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ISSN: 0193-4120 Page No. 9974 - 9979

Symposium on newborn screening for Duchenne muscular dystrophy',2013.

[21]. Shri Ram, 'Global muscular dystrophy research, A 25 year bibliometric perspective', Vol.65,2017.

[22]. Joan Lobo-Prat , Arvid Q L Keemink , ' Switching Proportional EMG Control of a 3D Endpoint Arm Support for People with Duchenne Muscular Dystrophy',2015.

[23]. Ramkumar, S., SatheshKumar, K., &Emayavaramban, G. (2016). EOG signal classification using neural network for human computer interaction. International Journal of Computer Theory and Applications, 9(24), 223-231.

[24]. Wan, X., Zhang, K., Ramkumar, S., Deny, J., Emayavaramban, G., Ramkumar, M. S., & Hussein, A. F. (2019). A Review on Electroencephalogram Based Brain Computer Interface for Elderly Disabled. IEEE Access, 7, 36380-36387.

[25]. Emayavaramban, G., &Amudha, A. (2016). sEMG Based Classification of Hand Gestures using Artificial Neural Networks. Indian Journal of Science and Technology, 9(35), 1-10.

[26]. Fang, S., Hussein, A. F., Ramkumar, S., Dhanalakshmi, K. S., &Emayavaramban, G. (2019). Prospects of Electrooculography in Human-Computer Interface Based Neural Rehabilitation for Neural Repair Patients. IEEE Access, 7, 25506-25515.

[27]. Emayavaramban, G., &Amudha, A. (2016). Recognition of sEMG for Prosthetic Control using Static and Dynamic Neural Networks. International Journal of Control Theory and Applications, 2(6), 155-165.

[28]. Ramkumar, S., Emayavaramban, G., Kumar, K. S., Navamani, J. M. A., Maheswari, K., &Priya, P. P. A. (2020). Task Identification System for Elderly Paralyzed Patients Using Electrooculography and Neural Networks. In EAI International Conference on Big Data Innovation for Sustainable Cognitive Computing (pp. 151-161). Springer, Cham.

[29]. Krishnan, M. S., Ragavi, S., RamKumar, M. S., &Kavitha, D. (2019). Smart Asthma Prediction System using Internet of Things. Indian Journal of Public Health Research & Development, 10(2), 1103-1107.

[30]. G. Emayavaramban, A. Amudha*, Rajendran T., M. Sivaramkumar, K. Balachandar, T. Ramesh. "Identifying User Suitability in sEMG Based Hand Prosthesis Using Neural Networks" in Current Signal Transduction Therapy , (Pubmed& Scopus Indexed)
DOI : 10.2174/157436241366618060410054 2

[31]. MP Paulraj, SB Yaccob, A Hamid, B Adom, K Subramaniam, CR Hema , EEG based hearing threshold classification using fractal feature and neural network, , 2012 IEEE Student Conference on Research and Development (SCOReD), 38-41,2012

[32]. KamalrajSubramaniam, Nisheena V Iqbal, Classification of fractal features of uterine EMG signal for the prediction of preterm birth, Biomedical and Pharmacology Journal, VOI 11, 369-374, 2018.