International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

Detection of EEG Signal and De-Noising for Hypoglycemia detection by Brain Wave Sensor

Praveena Sindagi, Mahesh P K,

***Abstract*: *Electroencephalography (EEG) signs have remained proven an identical adaptable apparatus for recognition of dissimilar types of Brain infections. Nevertheless through footage of these signs, EEG records gets soiled by different clatter signs produced through supply line interfering, base-line-wander, probe association, muscle-movement etc. Such sound signs misinform analysis of brain that is not anticipated. To circumvent such problematic elimination of the sound signals been develop crucial. Owing to development of data and information equipment tele-medicine and e-health have developed prevalent in emerging and urbanized republics. In the examination drudgery we partake verified three dissimilar categories of adjustable filtering procedures to associate the presentations for scheming EEG signal as of arbitrary and Gaussian-noise. The main idea of the work is to interface the human brain signals and machine in an easy and cheapest manner to find out the various abnormalities in him. The methodology is as follows, we took brain-wave senor for acquiring of data from the person, and this is standard device available in market. The senor is connected to the laptop or system with the help of Bluetooth and the signals are acquired. The acquired signal will be a noisy signal which is to be de-noised and filtered for further process of detection. Random and white-Gaussian-noise is added with EEG signal and Adaptive filter with three different algorithms have been tested to reduce the noise that is added during transmission through the telemedicine system. Further based on the sum, mean and standard deviation parameters the individual is been evaluated the condition is been predicted. After an experimental learning of teenagers with type-1-diabetes (T1D), accompanying with hypoglycemic incident night, centroid, alpha-frequency condensed meaningfully and the centroid theta-frequency augmented meaningfully. The complete data remained prearranged hooked on a preparation set and examination customary arbitrarily designated. By means of proposed methodology, which was resultant as of teaching set through maximum log indication, projected blood-glucose summaries created a noteworthy relationship in contradiction of measured standards in assessment set.*

***Keywords:** Electroencephalography, Adaptive filtering algorithms, T1D, Gaussian noise, optimal Bayesian neural network*

I. INTRODUCTION

EEG restrained through an electro-encephalograph, is the bio-medical signal enchanting on superficial of physique correlated to reduction & reduction of brain.

Manuscript published on November 30, 2019.
* Correspondence Author
Praveena Sindagi*, Assistant Professor, Dept. of Electronics and Communication, Government Engineering College Raichur,
Dr. Mahesh P K, Professor and HOD. Dept. of Electronics and Communication, ATME College of Engineering, Mysuru,

And the signal signifies an enormously vital amount for doctors as it affords vigorous info about patient brain disorder with overall fitness. Usually, frequency group of EEG is 1 - 60 Hz. Inside brain there exist a particular electrical

transmission structure which safeguards brain to reduce & contract in synchronized & operative style. EEG footages might have mutual relics with noise instigated by topographies such as power-line intrusion, exterior electromagnetic arena, arbitrary body activities & breathing. Diverse kinds of alphanumeric filters might be used to eliminate signal apparatuses from unsolicited frequency-ranges. Since it is problematic to smear filters with constant co-efficient to decrease biomedical-signal sounds since human behavior is not meticulous liable on time, adaptive-filtering method is obligatory to overawe the problem. Adaptive-filter is designed by means of dissimilar algorithms such as least-mean-square (LMS), Recursive-least-square (RLS), Normalized-least means-square (NLMS). In telemedicine system diverse kinds of biomedical signals like ECG and EEG wants to be transmitted over communication structure [7]. Through transmission of this kind of biomedical signals the chance of getting corrupted by common noise is identical high.Hypo-glycemia is furthermost mutual side-effect of insulin & sulphonyl urea in conduct of diabetes, & is a main fence to upholding reasonable long period glycaemic governor. Hypoglycaemia is a detail of life for maximum people by T1D. In average patient agonizes three chapters of indicative hypoglycaemia for every week & agonizes one or more chapters of unadorned, provisionally deactivating hypoglycaemia [8], frequently counting a coma or seizure. Hypoglycaemia is incapacitating for patients & their carers since of its related indisposition, loss of control & risk of demiseBrain hinge on a frequent fund of glucose & is defenceless to any glucose scarcity. Incapable to creäte or stock this main source of energy, brain is solitary of the primary organs pretentious to sank blood glucose-levels.
Hypoglycaemia advances when rates of glucose-entry interested in organized circulation are abridged comparative to glucose acceptance by tissues. Hypoglycaemia is generally modified certainly by the mixture of a amount of defence mechanisms. Primarily, a diminution in insulin excretion in retort to deteriorating blood glucose-levels arises [9]. As glucose-levels last to fall, a numeral of dismissed glucose pawn regulatory features are consecutively initiated at definite verges to ensure adequate glucose up-take to brain & other central nervous-system tissue-metabolism.

II. LITERATURE SURVEY

The removal of high resolution EEG-signals from recording, filthy with system-noise is a vital issue to examine in Telemedicine-system. The goal for EEG-signal augmentation is too distinct the valid signal-components from the un-desired relics, so as to contemporary an EEG that eases easy & precise construal. In our literature-review we found that "De-noising EEG-signal by means of Wavelet-Transform, where Wavelet is been castoff for de-noising EEG-signal but no further associated exploration paper has not originate wherever Mutual adaptive filter processes is not castoff. In such broadside the LMS process functions on an instant origin such that the weight-vector is efficient every new model with in the manifestation, grounded on an instant gradient estimation. There are firm clinical-application of EEG-signal dispensation that necessitate adaptive-filters with huge number of taps. In such request the conformist LMS [5] is computationally costlier to implement.The LMS system need little additions which are accordingly, extensively practical for acoustic-echo-cancellers. Nevertheless, there is strong necessity to advance the merging speed of LMS & NLMS procedures. The RLS algorithm, who's merging doesn't be contingent on the I/P signal, is fastest of all conservative adaptive-algorithms. The main disadvantage of RLS process is its large-computational cost. Though, fast RLS processes is studied in recently. In this broadside we goal to obtain a relative study of faster-algorithm. Distinct the NLMS & projection-algorithms, the RLS doesn't have a scalar step-size. So, the difference physiognomies of an EEG-signal cannot be replicated unswervingly in the RLS process [10]. Now, we study the RLS process from view-point of adaptive-filter since (a) the RLS can be viewed as a special-version of the adaptive-filter & (b) every limitation of the adaptive-filter has corporeal connotation. Computer models prove that this system meets faster double as conservative system.

Robotic glaucoma acknowledgment classification originated on wavelet dynamism edifices and ANN [1]:

Glaucoma is eye-disease it damages the optic-nerve of the eye & becomes severe over-time. It is instigated due to build-up of pressure-inside the eye. Glaucoma inclines to be inherited & may not show-up until far along in life. The recognition of glaucomatous-progression is one of the utmost important & most-challenging facets of main open-angle-glaucoma (OAG) management. The premature recognition of glaucoma is significant in directive to allow suitable treatment, monitoring, & to minimize the danger of irretrievable visual-field loss. Even though advances in visual imaging proposition the potential for former diagnosis, the best way is to encompass an amalgamation of info from structural & functional-tests. In this proposed-method both structural & energy features are well-thought-out then examined to categorize as glaucomatous-image. Energy supply over wavelet sub-bands were functional to find these significant texture-energy features. Lastly mined energy-features are practical to Rear Proliferation neural-network and Multi-layer Percept for operative grouping by seeing usual subject's extracted-energy features. Naïve-Bayes categorizes the images in database with accurateness of 91%. MLP-BP ANN system categorizes [3] the imageries in database with accurateness of 96%.

Instant brainwave meticulous interface by means of P323 module in EEG signal dispensation [2]:

EEG is a developing held of digital-signal processing. EEG is electrical sigs which is recorded with the help of sensors attached on humanoid scalp to sense human brain actions along scalp. EEG sig dispensation is a theoretically puzzling problem for scholars due to tremendously noisy environment associated to other dissimilar kinds of digital-data comparable voice or image. Nevertheless, EEG-signals also make auspicious re-search areas & applications for human-being. This paper drives at designing brain-controlled edge by means of P323 constituent in EEG-signal processing. The EEG signal P323 constituent is the event associated probable component provoked by the human brain in progression of decision-making. We practice the odd-ball architype accessible by P300 Speller to make the brain computer interface for topic to direct their intent of thoughtful via computer-screen. The device castoff to record the brain-signal is the Emotiv EPOC-headset. We deed the Bayesian-linear-discriminant-analysis (BLDA) to categorize the P300-signals [4]. We demeanor the tests to aid people express-thought in two out of six choice edges in real-time. The selections, which are obtainable on the computer-screen, might be any-thing from letters to the specific symbols or images. The investigational outcomes disclose the acceptable precision of correct-classification to be 88% & the best bit-rate of over 10-bits per minute.

III. PROPOSED METHOD

Hypoglycemia or fear of hypoglycemia establishes a significant-barrier to the accomplishment of good-glycemic governor the insulin treated diabetic-patients. Thru measuring physical responses resulting from EEG & analyzing these, we found that hypoglycemia can be sensed non-invasively.

As defined in flow-chart inward EEG-signal is digitized to progression by DSP. Signal is Initially de-noised, then permit over progression of frequency-shaping & amplitude restraining to retain signal-amplitude within perimeter. The detail explanation of method is as follows: -

Step1- The main use is to advance a system to sense the hyper-glucomatic role of a person grounded on EEG-signals.

Step2 -The EEG-signal has been I/P as text-file.

Step3 -Initially, de-noise function is used to eliminate noise from EEG-signal.

Step4 - Frequency-shaping Filter Primed the frequency-vector for frequency range 1000 -10,000 Hz. Time realm signal was rehabilitated to frequency field by means of FFT-function. Prepared the gain-vector of length-N, with zero, to stock gain co-efficient. The mini & max limit of chosen gain was 1 & 45 dB correspondingly. Set the gain for 1st set of frequencies

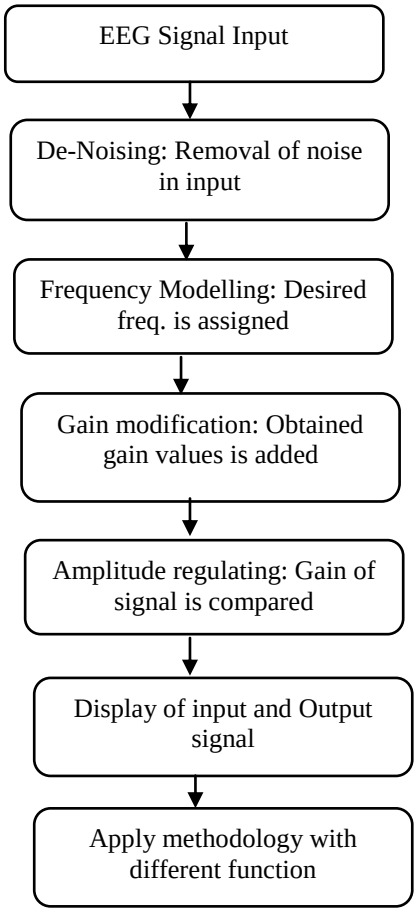

Fig 1. Proposed process flow

Step5 - After gaining frequency-shaping function, gain co-efficient from gain-vector is added to inward-signal to shape the signal conferring to transfer-function.

Step6 - Amplitude-Shaping.

To bound amplitude-signal, amplitude level of distinct model has remained associated through least & highest threshold-levels

If the signal-level is greater than Psat at that time decrease the signal-level to P_{sat}.

If signal-level is lesser than P_{min} at that time decrease the signal-level to zero.

Step7 - By means of above method frequency-shaping transfer function, magnitude and spectrogram versus time is plotted.

Step8 - By inspection the frequency-shaping function the condition for normality is plaid.

IV. RESULTS & DISCUSSION

Initially the EEG values are been extracted into text file in a PC/ Laptop, from the brain wave sensor which is fixed to the human brain and interlinked with Bluetooth. These text file data is further processed with proposed algorithm and analysed for defect.

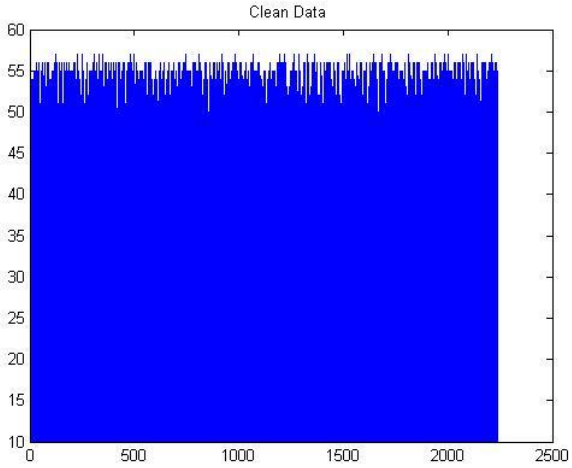

Fig. 2. Input Brain Wave raw data

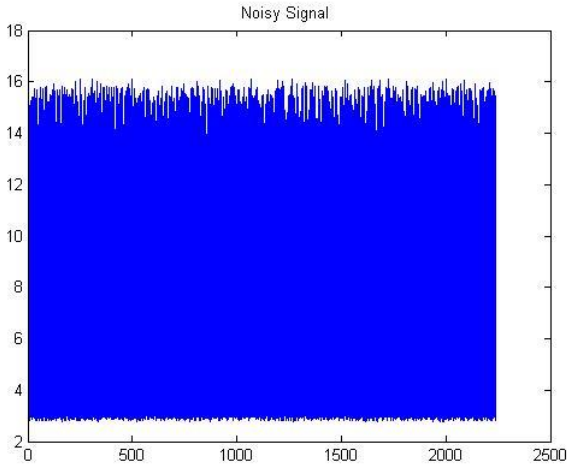

Fig. 3. Noisy data after adding Gaussian noise

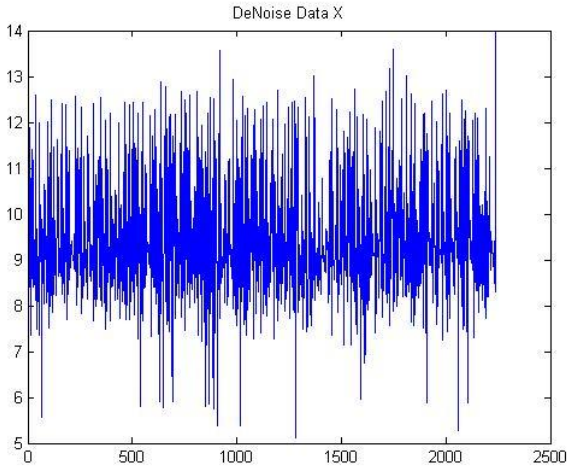

Fig. 4. De-noised Signal

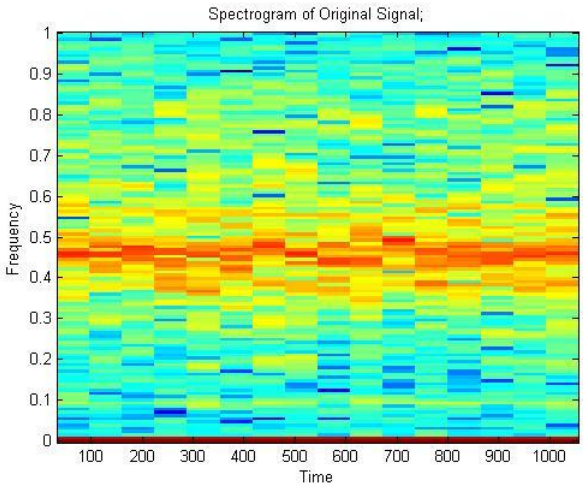

Fig. 4. Input Signal Spectrogram

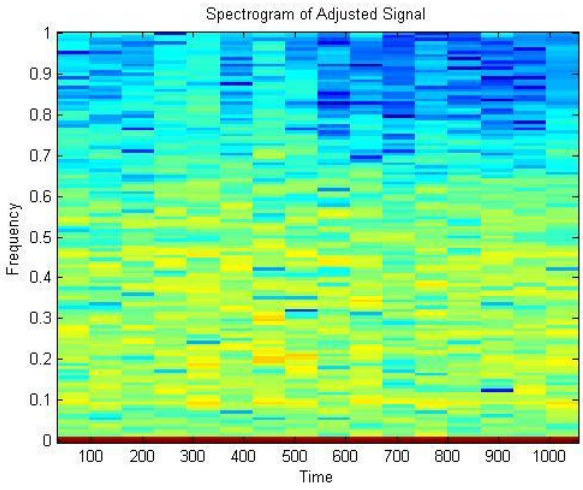

Fig. 5. Output Signal Spectrogram

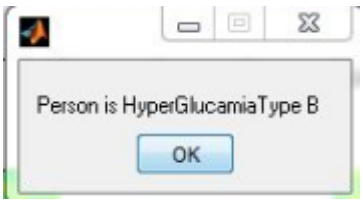

Fig 6 Final output

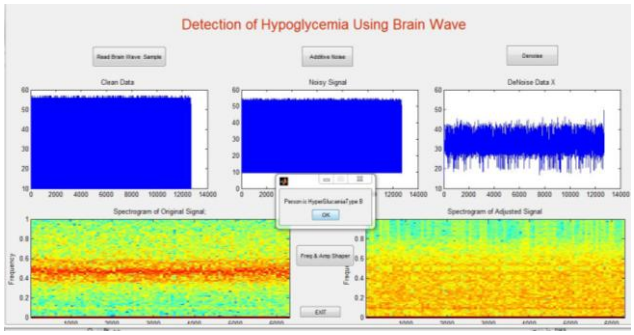

Fig 7 GUI of Complete software module

In this unit, performance of the projected tactic has been assessed by the simulations in MATLAB. The I/P EEG signal is altered to digital-signal, then treated by MATLAB coding to de-noise signal, generate frequency-shaping function to shape-frequencies & by amplitude restrictive produce the attuned or modified-signal which is presented to patient. By means of frequency-shaping function show in Fig 3, gain of EEG signal is revised on precise frequency range, & with amplitude restraining function the treated signal has increased the gain inside limits, Fig 4 displays the relative-magnitude of I/P EEG signal & processed O/P signal/adjusted signal with no noise.

Spectrogram is conspiracy of short period Fourier-transform of signal diverse frequency on time-axis. Spectrogram for I/P exhibitions skewed frequency in additional noise & spectrogram of attuned signal has shown the allied frequencies as exposed. The brighter colour exhibitions more energy.

V. CONCLUSION

In this exploration, we remain verified three dissimilar kinds of Adaptive-filtering procedures to associate the performances for scheming EEG signal as of arbitrary and Gaussian-noise. We have engaged brain wave senor for obtaining data from the person, this is the standard device obtainable in the market. senor is linked to the system or laptop with the help of Bluetooth. The attained signal will be a noisy-signal which has to be de-noised & filtered for supplementary process of recognition. Arbitrary noise & white Gaussian noise is additional with EEG signal & Adaptive-filter with dissimilar algorithms have been tested to lessen the noise that is additional during transmission over the tele-medicine system. The outcome of the experiment was good enough to extract the signal from human with a very least time consumption of 1 min. Further Gaussian noise addition and de-noising gave good spectrogram picture of the signal with an average bandwidth of 9 db. The de-noised signals were further used to classify the presence or absence of hyper glycaemia based on the mean and standard deviation thresholds. The classification of the abnormal signal is been done with an additional threshold of standard deviation and entropy values. The results were tested on 20 T1D patients and the accuracy was up to 95%.

VI. FUTURE SCOPE

With the proposed methodologies and algorithms we were able to achieve the desired outcomes in an effective manner. Hence forth the module can be further be used to compare the methodology with the other types of methodologies to predict the accuracy and effectiveness of algorithms. The system can be used in future telemedicine applications with computerized equipment's in real time.

REFERENCES

1. Pichet Srisangngam, Sorawat Chivapreecha, Kobchai Dejhan, "A Design of IIR Based Digital Hearing Aids Using Genetic Algorithm", The 8th Electrical Engineering/ Electronics, Computer, Telecommunications and Information Technology (ECTI) Association of Thailand - Conference 2011, ISBN: 978-1-4577-0424-6.
2. Gayathri R. ; P.V. Rao ; Aruna S, "Automated glaucoma detection system based on wav elet energy features and ANN", 2014 International Conference on Advances in Computing, Communications and Informatics (ICACCI)24-27 Sept. 2014, ISBN: 978-1-4799-3080-7.

3. Ha Hoang Kha, “Real-time brainwave-controlled interface using P300 component in EEG signal processing”, 2016 IEEE RIVF International Conference on Computing &Communication Technologies, Research, Innovation, and Vision for the Future (RIVF)7-9 Nov. 2016. ISBN: 978-1-5090-4134-3
4. Robert W. B¨auml and Wolfgang S¨orgel, “Uniform Polyphase Filter Banks For Use In Hearing Aids:Design And Constraints”, 16th European Signal Processing Conference (EUSIPCO 2008), Lausanne, Switzerland, August 25-29, 2008,
5. Trudy Stetzler, Neeraj Magotra,Pedro Gelabert, Preethi Kasthuri,Sridevi Bangalore, “Low-Power RealTime Programmable DSP Development Platform for Digital Hearing Aids”,application report published by Texas Instrument ,2000.
6. Robert W. B¨auml and Wolfgang S¨orgel, “Uniform Polyphase Filter Banks For Use In Hearing Aids:Design And Constraints”,16th European Signal Processing Conference (EUSIPCO 2008), Lausanne, Switzerland, August 25-29, 2008, ISSN: 2219-5491.
7. Lien B. Nguyen, Anh V. Nguyen, Sai Ho Ling, “An Adaptive Strategy of Classification for Detecting Hypoglycemia using Only Two EEG Channels”, 34th Annual International Conference of the IEEE EMBS San Diego, California USA, 28 August - 1 September, 2012, pp3515-3518.
8. H. T. Nguyen and T. W. Jones, "Detection of nocturnal hypoglycemic episodes using EEG signals," in 32nd Annual International conference of the IEEE Engineering in Medicine and Biology Society, Argentina, pp. 4930-4933, 2010
9. A. Delorme and S. Makeig, "EEGLAB: an open source toolbox for analysis of single-trial EEG dynamics including independent component analysis," Journal of Neuroscience Methods, vol. 134, pp. 9-21, 2004.
10. W. Clarke, T. Jones, A. Rewers, D. Dunger, and G. J. Klingensmith, "Assessment and management of hypoglycemia in children and adolescents with diabetes," Pediatric Diabetes, vol. 10, pp. 134-145, 2009.

AUTHORS PROFILE

Mr. Praveena Sindagi, is a Assistant Professor in the Department of Electronics and Communication Engineering of Government Engineering College Raichur, since 2011. He is pursuing Ph.D from visveshwaraya Technological University, Belagavi in the field of Biomedical signal/image processing. He obtained his M.Tech (Digital Communication) from BMS College of Engineering Bangalore in 2008. He obtained his BE (Electronics and Communication Engineering) from Visveshwaraya Technological University, Belagavi in 2003. He has both industrial as well as academic exposure owing to his earlier services in industries and academic institutes spread over the states of Karnataka.

Mr Praveen Sindagi having total 14 years of teaching experience in Electronics and Communication Engineering. His fields of interests are: Signal processing, Image processing, Speech processing, Communication, Networking.

Dr. Mahesh P K, is a diligent techno savvy Professor with excellent academic and research track record having 16 years of experience in the area of Electronics and Communication. Dr. Mahesh carries his academic credentials with Bachelors of Engineering in electronics and communication, Masters of Technology VLSI Design and Embedded Systems and PhD in Electronics from University of Mysore, Mysore.Dr. Mahesh has extended his service at various levels in teaching, initially as Lecturer, then Assistant Professor, Associate Professor and now as Professor and Head. Dr. Mahesh has been into research for the last 9 years working in the field of Image processing, Signal Processing and VLSI. He also authored more than 40 research articles at both National and International levels. His research articles have been referred and cited by other contemporary researchers across globe more than 50 times for the last 4 years. He currently is guiding6 students for their PhD.Dr. Mahesh has been identified as an expert at International level in his area of research for many journals. He has delivered Special lectures on Image processing, Pattern recognition, and VLSI. Prof. Mahesh is known for his lecturing in his area of research interest. He is the Editor-in-Chief for many international and national conference/Journals, also acted as Chairpersons.