Falsehood Detection by using Brainwaves

Pooja Shankar B S
MTech, IV Sem, Industrial Electronics, RNSIT,
Bengaluru, Karnataka

Mallikarjun H M
Asst Prof, Dept. of EIE, RNSIT
Bengaluru, Karnataka.

Abstract- The study of physiological methods for Falsehood detection tests using the emotional disturbances began in early 1900s. The necessity of Falsehood detection has been a part of our society from centuries ago. Various needs hovered over the society raising the need to develop fool proof methodologies for Falsehood detection. The classical comparative questioning tests have been tending to infer ambiguous results against which new robust methodologies are being researched upon for obtaining more efficient Falsehood detection set up.
Electroencephalography (EEG) is a non-invasive method to measure the activity of brain through the electrodes attached to the scalp of a subject. Electroencephalogram is a record of the electric signals generated by the synchronous action of brain cells over a period of time. The main objective is to gather and identify the meaningful data through this activity which can be assimilated for providing inference for Falsehood detection in future diagnosis. This work proposes a method for Falsehood detection using Brain waves recorded on random persons of different age groups and social sects. The statistical analysis is conducted using MATLAB V 7.0. It is a high performance language for technical computing which saves a lot of time with simplified analysis techniques.

In this work focus is made on Fuzzy based Falsehood Classification. 72 Samples are prepared by asking questions from standard questionnaire. By using neurosky's mindwave kit brain waves are recorded at the forehead values are tabulated accordingly. 52 data samples trained and 20 are tested. 1.46 e-15 testing error is observed after plotting test FIS against training data. As mindwave kit is wearable with Bluetooth support this work may be used in various applications.

Keywords—cEEG, Mindwave, Lucid Scribe, ANFIS

I. INTRODUCTION

Falsehood detection, also known as Lie detection utilizes questionnaire accompanied with technology which record the physiological functions to determine truth and falsehood in the response form a subject. These methods of Falsehood detections are used by law enforcement individuals and have its roots from past ages. There are many methodologies for Falsehood detection, one being a very common and long used called polygraph. Scientists inferred that these results are correct only in specific events and not applicable to screening where it works less well.

The ability to detect Falsehood has important legal, moral and clinical implications. These methods have also extensively received resuscitated interest from scientific community worldwide. In current times, the polygraphic tests are most widely used technique for the quantitative discrimination between deceptive and truthful responses. These methods rely on autonomic nervous system response such as respiration pattern, cardiovascular measures and electro dermal response (EDR). But these methodologies are regarded as useful in specific cases and have a stand of being ambiguous in various situations. Researchers are involved in redefining methodologies for having a near to accurate pattern for Falsehood detection using more efficient process.

Electroencephalography (EEG) is the focus of present work. It is an electrophysiological monitoring method to record electrical activity of the brain. It is typically noninvasive, with the electrodes placed along the scalp, although invasive electrodes are sometimes used in specific applications. EEG measures voltage fluctuations resulting from ionic current within the neurons of the brain. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a period of time, as recorded from multiple electrodes placed on the scalp. Diagnostic applications generally focus on the spectral content of EEG, that is, the type of neural oscillations (popularly called "brain waves") that can be observed in EEG signals.

The aim of this study is to revive a methodology to detect Falsehood using EEG. A primary database of brain signals will be recorded by indulging the subjects to truth and false situations. The data will be processed in MATLAB for extracting feature code and classify the results in this tool itself. This database will be utilized to implement the decisions on Falsehood or truthful responses in future tests.

The steps involved are:

➢ Collecting Truth-Falsehood EEG data from subjects using mind wave reader.
➢ Extracting desired features from EEG signals.
➢ Statistical organization of database using MATLAB.
➢ Classification of parameters for Falsehood detection by Neural Network Pattern Recognition.

The human brain is made up of billions of interconnected neurons the patterns of interaction between these neurons are represented as thoughts and emotional states. Every interaction between neurons creates a minuscule electrical discharge; alone these charges are impossible to measure from outside the skull. However, the activity created by hundreds of thousands concurrent discharges aggregates into waves which can be measured.

Different brain states are the result of different patterns of neural interaction. These patterns lead to waves characterized by different amplitudes and frequencies; for example waves between 12 and 30 hertz, Beta Waves, are associated with concentration while waves between 8 and 12 hertz, Alpha Waves, are associated with relaxation and a state of mental calm. (The contraction of muscles is also associated with unique wave patterns, isolating these patterns is how some Neuro Sky devices detect blinks.)

All electrical activity produces these waves (even light bulbs), thus all electrical devices create some level of ambient

"noise"; this "noise" interferes with the waves emanating from the brain, this is why most EEG devices will pick up readings even if they are not on a person's head. Measuring mental activity through these waves is like trying to eavesdrop on a conversation at a loud concert. In the past, EEG devices circumvented this problem by measuring these signals in environments where electrical activity is strictly controlled and increasing the signal strength of the data coming from the brain through the application of a conductive solution.
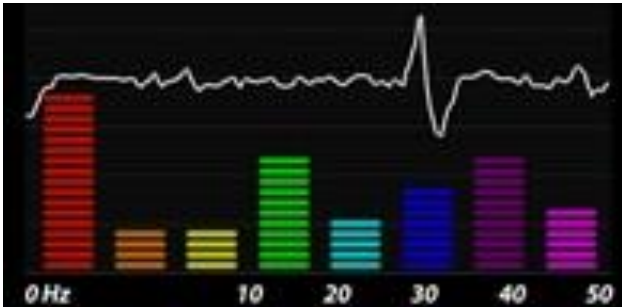
Fig 1 Raw Brainwaves and Power Spectrum

II. LITERATURE SURVEY

Idea to control robot by EEG signal, from the brain, in this paper explained about the assistant robots controlled to help the handicap and physically disabled people by measuring and detecting their support to action by using biosensor. [1]

Including emotion in to the human-computer interaction (HCI), while emotion due to watching emotional videos the difference in the brain electrical signals. Feature algorithm is for performing optimized sequential forward floating. [2]

The data which is already pre-processed and obtained it from DEAP database collected. Considered only alpha and theta were the subjects of interest neural network used for the emotion classification into negative/excited, positive/calm, negative/calm and positive/excited is considered db4 wavelet coefficients for feature extraction and signal decomposed to different EEG bands. [3]

Brain electrical signals is of different types, which are occurs for an different types of emotion in different ranges, these are collecting from the electrode we are going to use "mind wave mobile" that helps to get the raw EEG signals. In previous papers they discussed about detection and prediction of Emotions, idea that to get identifying the different emotions of a person easily by using the Neuro-fuzzy logic in the MATLAB, helps to get the mental state evaluation using ANFIS processing.

III. FUNCTIONAL MODEL

The Electroencephalogram (EEG) signals are obtained by using Mind wave kit. Mind wave reader is EEG technology driven device which measures brain wave signals and monitors the attention and relaxation level if subjects as they interact with stimulus. These signals are processed in MATLAB which classifies the data sing classifier tool in it. The features are extracted from frequency bands alpha, beta, delta, gamma and theta.

Block diagram for Falsehood detection using brain signal processing is as shown in Fig 2.
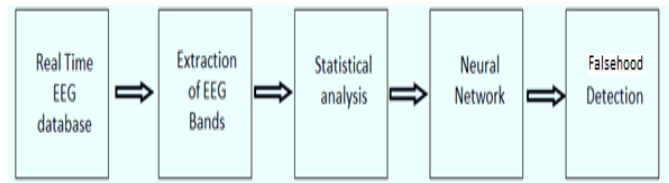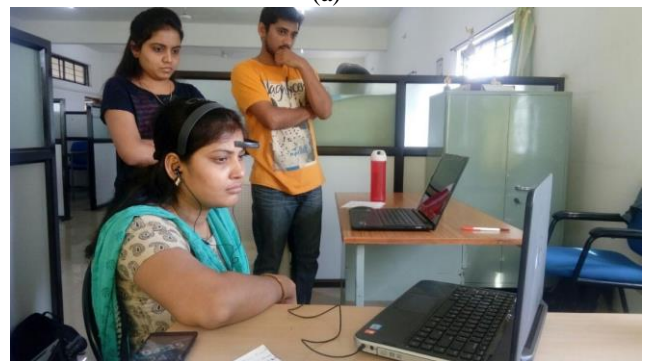

Fig 2 Block diagram of the proposed EEG Falsehood detection system

In this work Lucid scribe software is used. The Lucid Scribe software supports the data extraction from the human brain and it saves the extracted data in the duration of 1min. Then the data exported to excel sheet based on time of data sample taken.

3.2 Data Collection

(a)

(b)
Fig 3(a) & 1(b): Data Collection by kit

We have collected the data from the different persons asking them the different questions and making them to tell the correct answer first and then the wrong answer for the same questions. To check the connectivity we have used the software called Mindwave mobile core.

IV. RESULTS & DISCUSSION

Brain waves are acquired by using neuro sky's mindwave kit. Samples with different age group and different gender are taken. Lucid Scribe application will give different bands of brain waves with respect to time. Based on quisionarrie 1min data is taken for truth and false answers. In Lucid Scribe mindwave bands are collected. The data is tabulated for age, gender, Alpha min, Alpha max, Alpha avg, gamma min, gamma max, gamma avg, theta min, theta max, theta avg, delta min, delta max, delta avg.
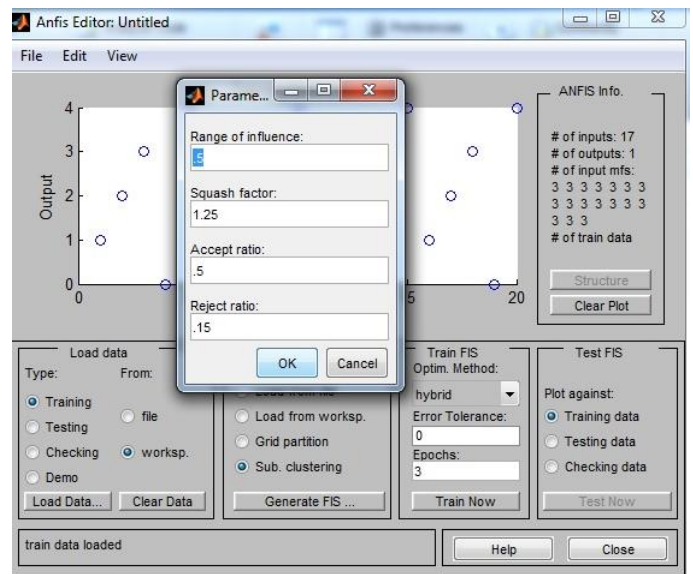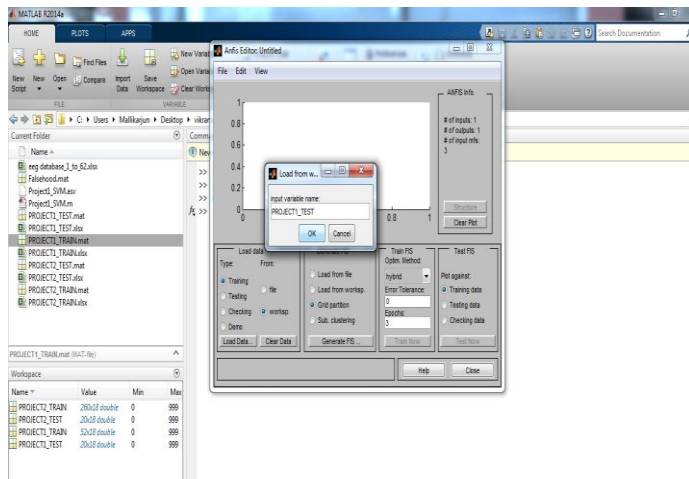
Special Issue - 2016

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
ICACT - 2016 Conference Proceedings

The work is conducted by classifying data sets in ANFIS.

A. *PROJECT1_TRAIN and PROJECT1_TEST mat files are loaded*
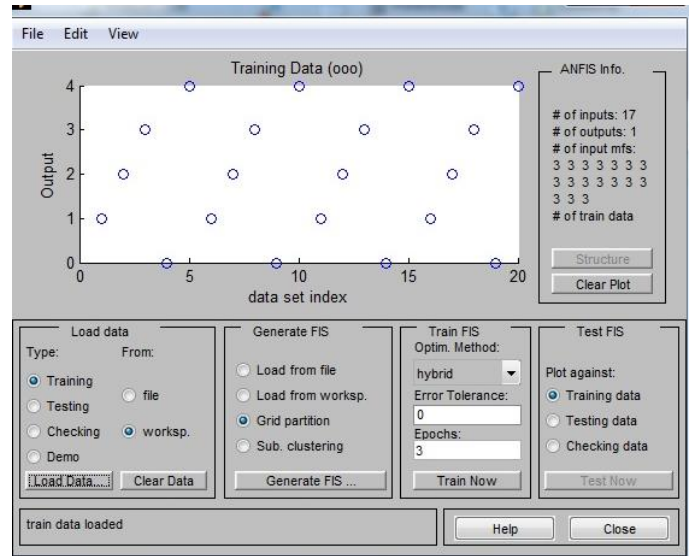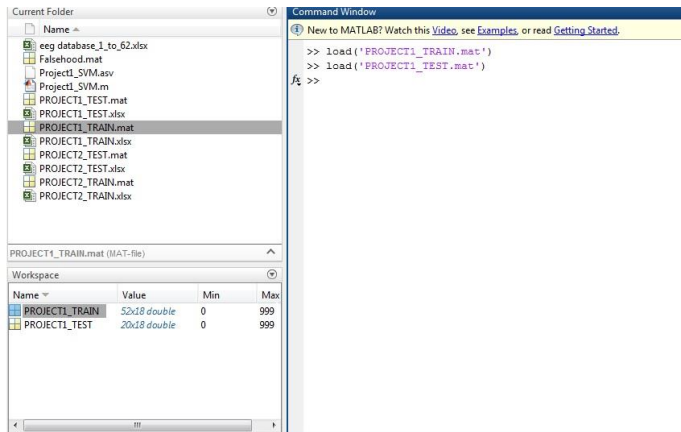
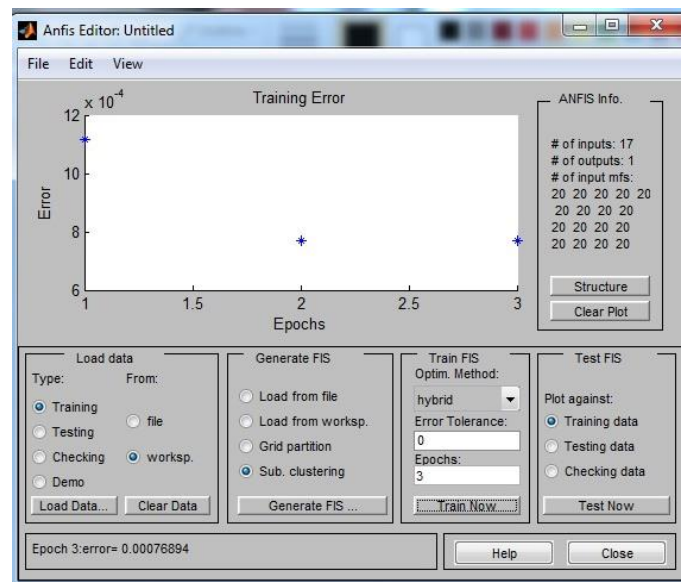### B. *Run system command Anfisedit in Matlab.*
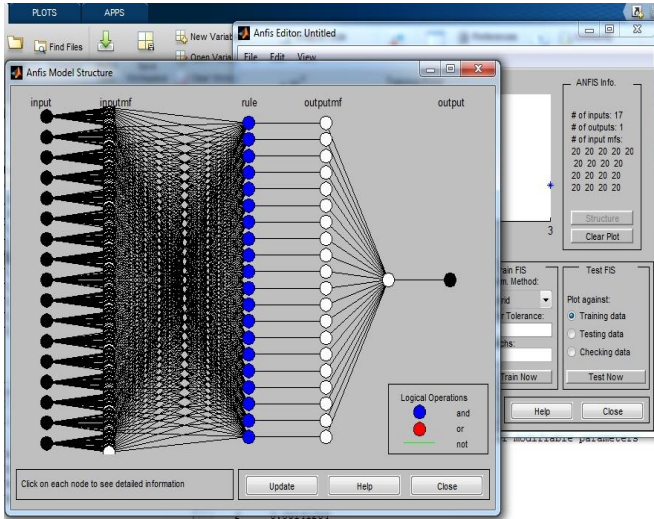
Load workspace PROJECT1_TRAIN

C. *52 samples are trained by choosing 3 epochs*

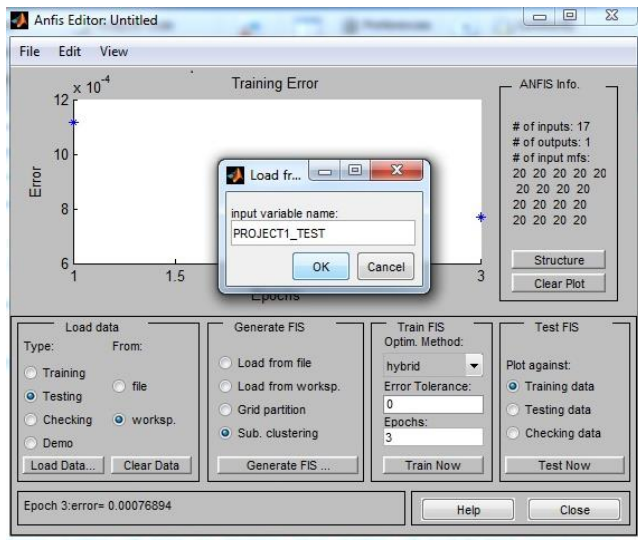Truth answers with respect to questionnaire are trained as : 1, False answers are trained as : 0.

This is given by entering values in the last column of training and testing workspaces.
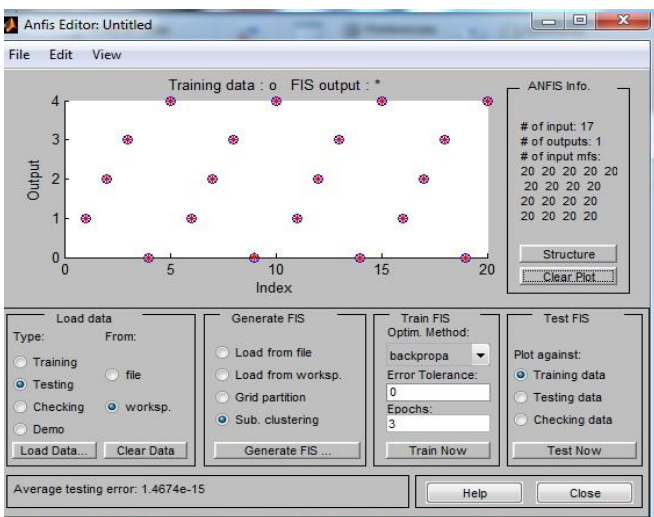
Special Issue - 2016

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
ICACT - 2016 Conference Proceedings

D. FIS STRUCTURE

E. 20 samples are tested by loading test workspace-PROJECT1_TEST

F. After generating FIS testing data 1.46 e-15error is observed.

V. CONCLUSION

In this work focus is made on Fuzzy based Falsehood Classification. 72 Samples are prepared by asking questions from standard questionnaire. By using neurosky's mindwave kit brain waves are recorded at the forehead values are tabulated accordingly. 52 data samples trained and 20 are tested. 1.46 e-15 testing error is observed after plotting test FIS against training data. As mindwave kit is wearable with Bluetooth support this work may be used in various applications.

VI. FUTURE WORK

Falsehood detection is a challenging task which place important role in different social applications. This work may be improved by preparing large data samples and training them in the fuzzy system. Advanced neural network methods with large data samples will give improved result.

REFERENCES

[1] "A comparison of methods for ERP assessment in a P300-based GKT"; Vahid Abootalebi, Mohammad Hassan Moradi, Mohammad Ali Khalilzadeh; International Journal of Psychophysiology 62 (2006) pp: 309–320, www.elsevier.com/locate/ijpsycho

[2] "A model of auditory deviance detection"; Emine Merve Kaya and Mounya Elhilali; 978-1-4673-5239-0/13/$31.00 ©2013 IEEE

[3] "Brain fingerprinting"; Dhiraj Ahuja, Bharat Singh; Journal of Engineering and Technology Research Vol. 4(6), pp. 98-103, November 2012 http:// www.academicjournals.org/JETR DOI: 10.5897/JETR11.061 ISSN 2006-9790 ©2012 Academic Journals.

[4] "BRAIN FINGERPRINTING"; ASHWINI V. SHARMA ,Dr. GANESH S. SABLE , Department of Electronics Engineering, SavitribaiPhuleWomens Engg. college, B.A.M.U. University, Aurangabad, Maharashtra,India.ashwinisharma.108@gmail.com, sable.eesa@gmail.com

[5] "A novel approach for detection of Falsehood using Smoothed Pseudo Wigner-Ville Distribution (SPWVD)"; Elias Ebrahimzadeh1, Seyed Mohammad Alavi, Ahmad Bijar, AlirezaPakkhesa; November 2012.

[6] "A New Method for EEG-Based Concealed Information Test"; Deng Wang, Duoqian Miao, and Gunnar Blohm, IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY, VOL. 8, NO. 3, MARCH 2013

BIOGRAPHICAL NOTES

Pooja Shankar B S is pursuing MTech IE in RNSIT. Her area of interest is EEG Signal Processing and Networking applications.

Mallikarjun H M is currently working as an Assistant Prof in dept. of EIE, RNSIT, Bangalore. His area of interest is EEG Signal Processing and VLSI applications. He is presently working on Brain disorders, Depression behaviour by using EEG signals. He published papers in different conferences on emotional classification, Sleep disorders and alcoholism by using brain waves.