

Aggression Detection in Alzheimers and Dementia Patients

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ABSTRACT

The main aim of our project is to provide a solution to patient-on-patient and patient-on-caretaker violence mainly concentrated on people suffering from Alzheimer's and Dementia. This is done by considering various parameters such as Heartbeat, EEG signals, Facial Detection, Voice Recognition and Sweat by accurately differentiating them as primary. The final product would be an application with all integrated features providing continuous updates about the patient in a well-defined manner which would further help the caretaker to carry out the required action in response to the aggressive nature of the patient.

Keywords: EEG signals, Facial Detection, Voice Recognition.

I. INTRODUCTION

Aggression can be defined as a state of mind in which an individual is subjected to uncontrollable anger or antipathy resulting in a hostile behavior causing harm to them and/or the people around them by the means of a physical or verbal attack, triggered by anxiety, depression, unrest, un-friendly environment sometimes un-controllable emotions whose occurrence may be sudden and due to apparent reasons.

There is a general misconception between aggression and violence, as in a person may indulge in a violence act with aggression, but a person with aggression need not necessarily engage in violence attack.

Aggression has been a major problem rather than disorder which exponentially has increased over the past decade not only in the adults, but even in children whose cause is stated unpredictable and mostly dependent on the vicinity of people or the environment the person is subjected to the age group

of 80 above. The next age group prone to the same is in the range of 60-80. Very few cases were reported in young adults of age group 15-30.

There are 3 phases in the implementation:

- First Phase: This phase includes the monitoring and detecting the parameters mentioned above from the patient and then sending the values to the database. The Alzheimer's patient's activities are notified and compared with a base value in the processing part.
- Second Phase: This is the processing part which has both front end and back end. In the backend, the received input is differentiated into different parts and then processed. They are actually compared with pre-determined values of the parameters of the patients in which it will be triggered to a text. The next step is that the text will then be divided into different variables, with each variable being measured separately.
- Final Phase: In this phase, the output will be of two stages- one output will be continuously

displayed on the UI, to make it available for those who are using the website and the other output will be given to the care-taker based upon the conditions.

A person suffering from aggression can be a harm to his self and/or to the people around him.

We hence are in a state where the use of advance technology may produce results to solve the problem in a more feasible manner and hence reduce the emotional constraint which the person may be subjected to.

I in the following report have stated reasons leading to its cause and have put forward my best to identify solutions to the same.

II. METHODS AND IMPLEMENTATION

ANALYSIS

One of the method of detection of is through Facial Expression Recognition Analysis, in which each facial movement is considered to be Action Unit (AU), so eventually all the Action Units are detected and all other facial expressions are filtered from aggression through the Local Binary Patterns and Gabor Filter, so suppose a patient's facial

Expression is detected, then the parameters for the tensed expressions are filtered out separately and are sent to the related care-taker through the base station.

Local Binary Pattern Algorithm:

The algorithm is based on the comparison of a pre-defined algorithm with the formulated algorithm, which is got from the corresponding facial expression.

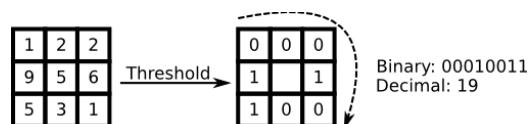
Let us consider an example by formulating a matrix. Let us first have a center pixel, then depending upon the facial input, the successive pixels are filled, if the

intensity of the pixel is greater than that of the center pixel, then 1 is entered else 0 is entered.

Once a complete matrix is completed, then it is compared to pre-defined and also constant matrix for aggressiveness.

If both of the matrices match, then a signal is sent to the care taker conveying the condition (most probably hostile) of the patient.

The following example is a similar to the above explained one, but the threshold complexities are neglected here and instead it is compared with a constant and static matrix.



The Gabor filter is basically a device which detects pattern changes and produces a corresponding result. The texture pattern is believed to be different for different expression, considering the contraction and relaxation of facial muscles.

RELATION OF AGGRESSION WITH ALZHEIMERS DISEASE

One of the most prime causes of Alzheimer's disease is anxiety, apathy, leading to deterioration of blood cells, intervening with daily activities, initially causing temporary memory loss and finally causing permanent change in the brain cell orientation, but a most important parameter to be considered are the age and the stress level of the person. Observations were made that people having extreme level of aggression, especially passive aggression are more prone to Alzheimer's disease, the reason that aggressiveness of certain high order cause changes in the brain fluid, leading to damage of brain cells prime cause to Alzheimer's and Dementia.

SYMPTOMS AND AGE RANGE

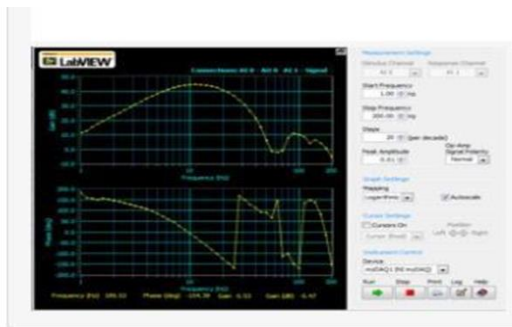
Appreciable change in day-to-day behavior is common.

Questioning of their activities and temporary memory loss.

A patient suffering from the disease will suffer from delusions, accuse others of theft and also infidelity in some cases this is most common problem of passive aggressiveness noticed.

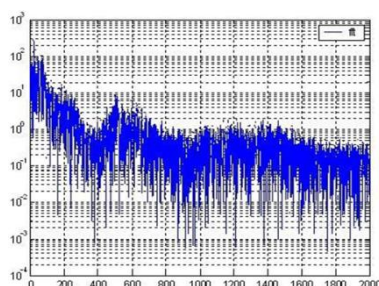
This disorder is most commonly detected individuals in the age group of 80 above. The next age group prone to the same is in the range of 60-80. Very few cases were reported in young adults of age group 15-30.

EEG SIGNALS:



- The above (FIGURE 1) graphs show a part of analysis phase of EEG signal data monitored continuously.
- The data is being received from one of our volunteer team member.
- The reading units are measured in terms of frequency response from the EEG sensors.
- Varying frequency as a result of varying beta-waves produced by brain helps in detection of aggression behaviour.
- EEG data is considered as a primary parameter for aggression detection.

VOICE SAMPLING:



- The voice recognition includes voice sampling in order to get digital data of words to be registered by the device.
- Sampling also includes scaling up the clarity of words so that precision is maintained and would also help in training the machine with words specific to a person to understand that he/she is aggressive.
- The above is generated by the initial variables from the MATLAB software fed from the Arduino board sensor connected to wireless Microphone near the person's shirt collar.
- The data is analyzed and fed to IBM SPSS software for matching the aggression tone characteristics.
- Voice data is sampled at 4000 samples/second. The above figures show the emotion of a person in terms of level of emotion based on the words that the person speaks and also on his/her tone/pitch of voice.
- The red line in the graph represents aggression. The depth of aggression is recognized by the crest of the line. The respective voltage values are recorded and fed for analysis. Voice is taken as a primary parameter.

VISUAL RECOGNITION:



Clearly we can understand that the software has identified that the person is about to get aggressive which is true to the image that it has captured.

Hence continuous input to the analyzer will help in identifying the aggressive behavior.

Facial recognition is one of the primary parameters.

III. RESULTS AND DISCUSSION

A. ALGORITHM:

The algorithm is such that, the first stage of triggering the text is based upon the values of heart rate, blood pressure, motion detection, if these values show abnormality, then the speech detection is checked for variations, if both the conditions are satisfied, then the next level is about the level of aggression detection, as in whether the patient is under normal circumstances, person is on the verge of aggression, the patient has turned hostile.

The webpage or the UI interface in the Desktop will display, continuously, the recorded values, ready to be accessed at any time.

The android wear with the Nurse will also display these details, but in a more constrained way, such that it will be more concentrated in displaying a three-signal output, depending upon the aggression level, with taking into consideration a considerable amount of time for the care-taker to respond to the patient.

B. WORKING:

Firstly, the collection of all the patient's medical history needs to be loaded onto a database. These details will serve as the basic comparison parameter (baseline) to detect the aggression in an individual. The output from all the sensors are read and processed as follows: Any changes in the above parameters will be notified to the caretaker on an hourly basis. To detect the various level of changes in

the aggression of the patients we calculate the level of aggression by multiplying the changes in each of the parameters with a predefined priority values. The value that is obtained is then checked for the range it lies in and from this the level of detection will be concluded. If the value of the levels of aggression is below the normal levels, the caretaker will not be notified. If the value of the levels of aggression is in tolerable level, then the caretaker is warned. If the value of the levels of aggression is above the tolerable level, then caretaker is alerted with an immediate assistance required message

Table 1

Expression	Expected Emotion	Actual Emotion	Score
"I am so happy that I got selected"	JOY	JOY	0.82
"What the hell"	FEAR	FEAR	0.9
"Don't you dare mess up with me"	ANGER	ANGER	0.64
"This is so disgusting"	DISGUST	FEAR	0.5
"I am very sad"	SAD	SAD	1
"I don't like dustbins"	UNCERTAIN	UNCERTAIN	0.89

IV. VOICE RECOGNITION READINGS

The above table provides the readings that were taken while using the voice recognition model, briefly explaining the expected result and the closeness to the result.

V. CONCLUSION

The above mentioned parameters for detecting aggression are large in number when compared to the number of parameters discussed in this paper, the

reason being that a lot of conditions such as the degree of intrusiveness, feasibility to both the end user and that of the patients were considered.

Though the above parameters require advancement, the baseline for considering the parameters are the same which is to have both accuracy and repeatability and also to establish a reliable connection between the cloud platforms and the end-user application.

Though the implementation of such advance technologies might question the reproducibility of the same, the use of Machine Learning Algorithms such as SVM (Support Vector Machine) provides a better approach towards the long-term solution of the problem.

VI. REFERNCES

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