AGGRESSION DETECTION

INITIAL REPORT

AGGRESSION DETECTION IN THE AREA OF ALZHEIMER'S DISEASE

PREPARED BY-
CHIRAG D.K
ACHARYA INSTITUTES,INDIA

Introduction

Dementia is the loss of cognitive functioning—thinking, remembering, and reasoning—and behavioral abilities to such an extent that it interferes with a person's daily life and activities. Dementia ranges in severity from the mildest stage, when it is just beginning to affect a person's functioning, to the most severe stage, when the person must depend completely on others for basic activities of daily living. [2]

Many conditions and diseases cause dementia. The most common cause of dementia in older people is Alzheimer's disease. Other causes include different kinds of brain changes that lead to vascular dementia, Lewy body dementia, and frontotemporal disorders.

Alzheimer's disease (AD) is an irreversible, progressive, age-related brain disorder that affects as many as 5 million Americans. It is the most common form of dementia, a broad term for diseases and conditions that damage brain cells and, over time, impair brain function. Alzheimer's causes once-healthy neurons—a type of brain cell—to lose their ability to function and communicate with each other. [1] Eventually, the damaged cells die.

While disease may simmer in the body decades before the first symptoms, late-onset Alzheimer's disease is typically detected in people age 65 and older. Rarely, it may occur at age of 30 or 40.

People with Alzheimer's disease encounter loss of memory, confusion and may also forget basic human routines. The more prominent effects of Dementia and Alzheimer's disease is the aggressive behavior of the patient during the later stages of the disease.

Aggressive behavior is a major problem for persons with Alzheimer's disease (AD). According to a survey, 15 to 34% of participants are reported to have engaged in recent acts of interpersonal violence. These behaviors have been shown to increase the risk of violence to public in general and also major threat to patient's life, placing a considerable premium on the identification of factors that cause or initiate aggressive behavior.

Aggressive behavior may be verbal like swearing, screaming, shouting, making threats or may be physical like hitting, pinching, scratching, hair-pulling, biting.

Aggression and Alzheimer’s

Aggressive behaviors may be verbal or physical. They can occur suddenly, with no apparent reason, or result from a frustrating situation. While aggression can be hard to cope with, understanding that the person with Alzheimer's or dementia is not acting this way on purpose can help.

While understanding what is causing the person's behavior can help detect aggression and find a solution, some possible explanations/causes for aggression could be biological, social or psychological.

Biological

- There may be pain, illness or physical discomfort.
- Side effects and/or taking too many medications may mean that a person becomes more confused and drowsy.
- The environment may not meet their needs or may be over-stimulating. It could be too hot or too cold, noisy or too bright. Poor eyesight or hearing can lead to misunderstandings and misperceptions.
- Hallucinations or delusions can be confusing and frightening, leading the person with dementia to respond to them in an aggressive way.
- The physical effects of dementia may have affected the person's judgment and self-control.

Social

- Lack of social contact and loneliness.
- Boredom, inactivity and sensory deprivation.
- Different careers coming in with a different approach or changing the established routine.
- Not liking or trusting a particular career.
- Trying to hide their condition from others.

Psychological

- The person with dementia may have a perception that their rights are being infringed or that they are being ignored. This may be due to misperceptions, memory difficulties or problems processing information, but it may also be true.
- The person may become frustrated at not being able to complete tasks.
- There may be depression or other mental health problems.
- A patient's intentions may be misunderstood. For example, personal care may be seen as threatening or an invasion of personal space.
- People may have difficulties understanding and interpreting the world around them, and may experience a different sense of reality from others. For example, if the person believes that they need to collect their children from school, they may become aggressive if they are prevented from doing so.

Biological Factors of Aggression and Violence:

There are many different biological functions that have been linked to aggressive and violent behavior. This is not to say that environment does not play a significant role in these behaviors, but there are studies to suggest that the biology of some disorders may be a more significant factor than environment.

Some of the biological factors affecting aggression are higher heart rate, hormones, perspiration, high blood pressure and high activity in frontal cortex of the brain.

Higher heart rate:

Heart rate has shown to be a well-established biological correlate of crime concerning aggression. During the episode of aggressive behavior heart rate tend to increase anywhere from 150 to 200+ depending on the severity of agitation.

Brain Signal:

The cerebral cortex has been the main portion of the brain studied when looking at violence and aggression. The cerebral cortex is the outer portion of the brain, which is divided into two hemispheres consisting of four lobes: frontal, parietal, temporal, and occipital lobes. Because the frontal and temporal lobes deal with goal-directed behavior, impulses, and emotions.

Micro Expression:

Facial micro expression is a brief, involuntary facial expression shown on the face of humans according to emotions experienced. These micro expressions can be studied over a course of time to set a baseline and then start comparing the patient's day to day expression to the set baseline. Depending on the outcome of that comparison, it can be established that whether the patient is undergoing an episode of aggression.

Perspiration:

Perspiration, also known as sweating is form of body's way of responding to internal bodily changes. That can changes in heart rate or can also be changes in certain kind of hormones. Higher heart rate or release of testosterone leads to activation of Eccrine sweat glands leading to sweating all over the body.

High Blood Pressure:

As a result of higher heart rate, blood pressure tends to increase in the human body which as a parameter to detect aggression can be very useful as it is easy to detect Blood pressure though readily available sensors/tools in the market.

Hormones:

A hormone is any member of a class of signaling molecules produced by glands in multicellular organisms that are transported by the circulatory system to target distant organs to regulate physiology and behavior. Testosterone has been the central focus for aggressive behavior studies. The relationship between testosterone and aggression has shown significant results in both men and women.

DETECTION OF AGGRESSION:

Detection of aggression can be very tricky given the fact that aggression is an emotion rather than definite symptom. Aggression is an expression which doesn't have set criteria through which it can be measured. Aggression as an expression can be measured by the biological factors causing it and also by the body factors which aid in it. Aggression in our body is mainly reflected by heart rate, micrographs, perspiration, high blood pressure and higher activity in frontal cortex of the brain.

As the factors established can reflect the condition, it is possible to detect aggression by monitoring the set parameters. The above stated parameters can be in such manner that initially it creates a baseline value for the patients and then keeps monitoring the real time values with set baseline of individual person. Once the system senses abnormality or spike in reading a signal can be sent to the care taker stating the condition of the patient along the details of the spiked values.

Following are the parameters which needs to measured and the method though which they can be measured –

Higher heart rate:

Medically it is established that there is an increase in heart beat once the patient is expressing aggressive behavior. Hence any wearable device measuring heart beat can be used to monitor this parameter. Of the shelf fit-bits can be used to measure the heart rate.

Brain Signal:

The cerebral cortex has been the main portion of the brain studied when looking at violence and aggression. Wearable EEG Meditation Headset measures brain waves, hence measuring frontal cortex signals for aggression can be done through EEG wearable devices.

Micro Expression:

Facial micro expression is a brief, involuntary facial expression shown on the face of humans according to emotions experienced. This can be achieved by many Open Source API(s) present in the internet domain. But this requires additional equipment like camera (CCTV, facial cameras etc.)

Perspiration:

Perspiration is form of body's way of responding to internal bodily changes. Of the shelf sweat patches are available which measures the glucose and the sweat level of the patient. This sweat patch can be linked with other monitoring devices to synchronize the real time readings.

High Blood Pressure:

As a result of higher heart rate, blood pressure tends to increase in the human body. The wearable fit bit which measures the heart beat calculates the blood pressure, hence wearable fit-bit can be used to measure the Blood Pressure.

Motion sensing:

Motion sensing can be used as an additional parameter to measure the aggression or as a trigger to start all other sensing devices.

Hormones:

Hormones are difficult to be measured and should be kept as last measure of monitoring aggression.

Requirements:

Purpose	Equipment	Cost (per piece)
Heart Rate	Laud Fitness Watch	$15
Brain Signal	NeuroSky Mindwave EEG Sensor	$80
Micro Expression	Camera and API	$100
Perspiration	Sweat detection Patch	$10
High Blood Pressure	Laud Fitness Watch	-

Along with the above mentioned requirement, basic requirement like a server to store values, processor to process the data, channel to transmit the data etc. are required.

Solution:

Aggression can be detected by reading the values from the devices, storing it in a database and then processing it for abnormalities once the baseline is set.

Following is the step by step process to detect aggression in cases of Alzheimer's and Dementia-

- Initially, the patient's heart rate, perspiration, blood pressure are constantly measured by using wearable devices like Laud fitness watch and Sweat detection patch. This will continuously measure the corresponding parameters throughout the day, giving necessary baseline measurements.
- During the episode of aggressive behavior, values of these parameters spike, triggering a signal to the caretaker to put the patient under continuous monitoring.
- Continuous monitoring is done through adding additional devices like NeuroSky Mindwave EEG Sensor, Camera and API for brain signal detection and micro-expression detections respectively.
- These will send the measurements of all the parameters to the caretaker and will keep informing about his condition. Once the caretaker feels that the readings are abnormal, he can take further necessary steps.
- Caretaker can confirm from this by additionally testing his hormones like testosterone.

CITATION:

Web Reference –

[1] https://www.nia.nih.gov/alzheimers/publication/2012-2013-alzheimers-disease-progress-report/introduction

[2] https://www.nia.nih.gov/health/topics/dementia

[3] http://www.alz.org/care/alzheimers-dementia-aggression-anger.asp

[4] http://www.webmd.com/alzheimers/guide/alzheimers-aggression#1

[5] http://www.alz.org/care/alzheimers-dementia-aggression-anger.asp

Literature Survey –

- Spontaneous facial expression recognition: Automatic aggression detection

  Ewa Piątkowska, Jerzy Martyna

  https://link.springer.com/chapter/10.1007/978-3-642-28942-2_14

- Audio-visual fusion for detecting violent scenes in videos
  http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.724.823&rep=rep1&type=pdf
- Automatic aggression detection inside trains
  http://mmi.tudelft.nl/pub/leon/436.pdf