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Autonomous Neuron Telematics Data Mining Architecture

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***Abstract*:-**

In this paper a data mining schema developed to analyze human brain Autonomous Neuron Telematic metrics during its functional period. The organization of modules and their staged data process functionalities are discussed. The architecture designed helps to improve the treatment strategies as well as doctors medical diagnosis process. It acts as a recommender system with clean interfacing to raw data processing. Also the paper focuses on neuron metrics and their data acquisition techniques.

Key Words: *- Tomography, Cell-Structure, Membrane, Fuzzy, Polar, Signal, Dendrite, Axon, Stem-cell, NSM (Neuron Signal Metrics), NM (Neuron Metrics).*

1. INTRODUCTION

Human brain maintains a complex structure enriched with great fuzzy logic and inference support. The fundamental cell structure that governs the functional process in Brain named as *Neuron* [8]. Neurons are specialized cells of the nervous system that transmit signals throughout the body. Research studies identified heterogeneous groups of cells used to form Brain Structures and most probably mammals may contain around 10^8 to 10^{11} neurons in brain [4][11]. Neurons have long extensions that extend out from the cell body called dendrites and axons [9]. Dendrites are extensions of neurons that receive signals and conduct them toward the cell body. The Autonomous Neuron collaboration with a great network structure governs the mental ability of humans. The way how neurons transmit and receive signals from other neurons/organs named as *Autonomous Neuron Telematics* (ANT).

The personality and behavior of humans highly influenced by *Neurological functions*, *Neural Connectivity* and *Neurotransmitter activities*. In this paper the Data Mining architecture developed extracts ANT data from f-MRI (*functional Magnetic Resonance Imaging*)/EEG (*Electro Encephalogram*)/ MEG (*Magneto Encephalogram*) devices [6]. Computer Tomography and Radiology scans [4] generate image data online highly interfaced OLAP (Online Analytical Processor) [12][15][16] needed to extract data from these devices. The raw data collected and transformed into databases are used in knowledge discovery, query based kiosks, recommender systems and diagnostic analyzers in medical domain.

In Section 2 the concepts like Neuron Structure, Telematics along with Neuron Metrics discussed. In Section 3 Data Mining architecture for ANT proposed. Section 4 describes the ANT mining process followed by Conclusion and future scope.

2. NEURON TELEMATICS

2.1 Autonomous Neuron Telematics

Human Brain neurons are autonomous in signal sensing and co-operative during signal processing. "*Telematics is the transmission of information signals between long distance nodes"*. Basically neurons telematics deals with sound, electric, photon (light) and Bio signal receiving and transmission. Figure 1 shows the telematic behavior of neuron cells in human brain.

2.2 Neuron Metrics

Neuron metrics are classified as two categories
One is '*Sensory Metrics*' and other is '*Cell Metrics*'. Sensory metrics are used to measure the characteristics of neuron sensory organs. Some of the useful metrics are signal type, strength, polarity and channel. Cell metrics are purely depends on cell characteristics such as axial dimensions, room type, fuzzy volume, leafs, soma, dendrite, axon and stem-cells. The communication behavior of neuron is highly influenced by these metrics. The characteristics of neuron metrics are shown in Table-1 given below

Table 1. Neuron Metrics

Metric	Characteristics
Signal Type	Sound, light, electric are common type of signals
Strength	Specifies the intensity of signal and how long it can be carried through nerves.
Polarity	Decides the –ve or +ve charge inside cells of neurons
Channel	The carrier of signals between neurons and its rate of signal transmission
Axial Dimensions	Used to represent neuron in temporal and spatial resolutions
Room Type	Decides the holding capacity of cells
Fuzzy Volume	Depends on wrinkled turns of sensory nerves respective neuron. Influences human IQ
Leafs	The number of siblings to a neuron which are also neurons
Soma	Bio-Solution around the nucleus of neuron.
Dendrite	Base nerves of neuron which attached to brain muscles through dendrite spines.
Axon	A long nerve fiber of neuron used to generate electric signals and vibrations over brain muscles.
Stem Cells	The root cells used to form a neuron

2.3 Measuring Devices

The special devices used for extracting the measures of ANT are as follows

Electroencephalography (EEG):

This device is capable to record brain statistics during functional period with high accuracy. Supports high amplification and detects short micro electric signals. It supports excellent temporal resolution with low spatial resolution. This device is highly useful in ANT data acquisition.

Functional Magnetic Resonance Imaging (f-MRI):

This device basically supports high spatial resolution and used to record statistics of sensory organs of neuron during responses for signals. Helps to gather metrics related to cell fluids of neurons. Best for ANT data acquisition with low investment compared to EEG.

Magneto Encephalography (MEG):

This device is a very high precise brain neuron metrics analyzer with combined features of EEG and f-MRI devices. This scan is strictly applied on static and motionless patients within enclosed chambers. Supports high spatial as well as temporal ANT data handling but cost is high.

Computed Axial Tomography (CAT):

This is a widely used device to analyze brain functionality and its neuron structures. Simultaneous visual array of X-rays continuously captures the ANT data of brain. Device is well suited to analyze structural data than telematics.

2.3 Neuron Structure

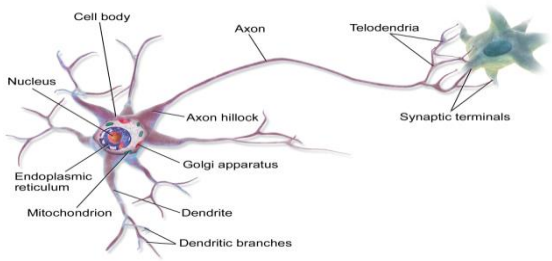

Figure 1. Neuron Structure

Neurons contain organelles similar to cells. Each neuron formed with Nucleus and Mitochondria. The other structures include Dendrites, Axons, Telo-Dendria (*special nerve structures support ANT*), Soma (*cell fluid generates electric/magnetic vibration currents*). Each neuron attached to other organs/neurons using Synaptic terminals[8]. The Axon terminals transmit signals from neuron to spinal cord and cerebellum. Table-2 depicts the characteristics of elements in Neuron structure.

Table 2. Elements of Neuron Structure

Neuron Organ	Purpose
Nucleus	The stem cell life force centre. Governs the neuron activities
Soma	Cell fluid surrounds the nucleus and treated as cell body. It consist various life tissues.
Dendrite	These are like input channels to neuron which brings data from outside (organs, other neurons).
Axon	These are like output channels to neuron which carry signals from neuron cell to other organs or neurons.
Mitochondria	Neurons critically depend on Mitochondrial functions for signaling generation, neurotransmission processing.

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3. ANT-DM ARCHITECTURE

3.1 Existing System

The existing systems are not capable of performing knowledge inference as well as support for decision making over rule inferences on data generated by Medical Diagnostic Machines [14]. Major part of the analysis done by doctors. They examine multi variant raw statistics. This process needs high experience with huge set of case studies. Some situations need expert doctors hiring also.

3.2 Proposed System

The proposed system based on the architecture supporting Data Mining with integration of Multimedia Synthesizers. The basic data flow in ANT Data Mining architecture follows a pipeline based process for both online as well as offline data mining.

3.3 System Architecture

The architecture of ANT-Data mining system is shown in Figure-2. The staged functional process of each module in architecture as described below

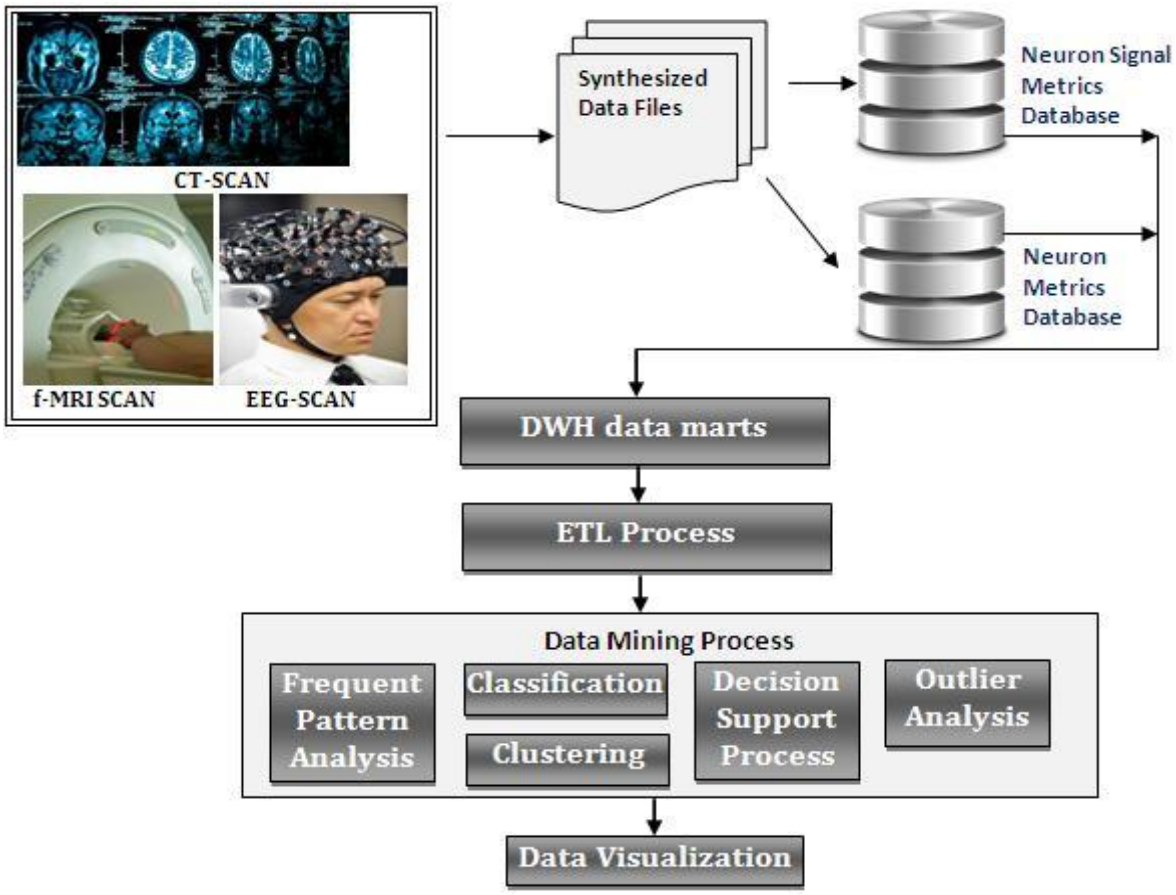

Figure 2. ANT Data Mining Architecture

***Data Acquisition Process*:**

In this process interfaces acquire analog data from medical diagnostic machines (CT- Scanner, EEG-Scanner and f-MRI Scanner).
This data synthesized to digital data and stored in multimedia format. These multimedia files into are transformed Multimedia Databases. The two major multimedia databases are NSM-*database* and NM-*database*.

***DWH Data Marts*:**

Warehouse data marts are generated from the NSM and NM databases using available any data mining softwares (Orange®, Tanagra®, WEKA®, Rapid Miner Studio®…). Once the data marts are generated data mining engines can extract data from data marts for further processing.

***ETL Process*:**
The data extracted from data marts undergoes Transformation and Loading process [17]. In this phase data refinement, filtering, noise removal of data takes place. Successful completion of ETL process generates training data set for data mining operations.

***Data Mining Process*:**
The major data mining techniques to perform meaningful information extraction from training data takes place here. The ANT data mining technique, training data sets and uses described in following Table-2.

Table 2. Data Mining Process over ANT data

Data Mining Technique	*Training Data Set(s)*	*Use*
Frequent Pattern Mining	NM-Dataset	Association rules for Neuron metrics (patients/humans)
Classification	NSM-Dataset	Classifying of neuron statistics over (Species, Signal Processing data and Fuzzy logic statistics)
Clustering	NSM-Dataset, NM-Dataset	Telematics clustering, behavioral clustering, zone clustering.
Decision Trees	NSM-Dataset, NM-Dataset	Spanning tree structures of stem cells, diagnostic Decision trees.
Outlier Analysis	NSM-dataset, NM-Dataset	Detecting anomalies in neuron statistics for on-line and off-line data statistics

4. ANT MINING PROCESS

4.1 Process flow

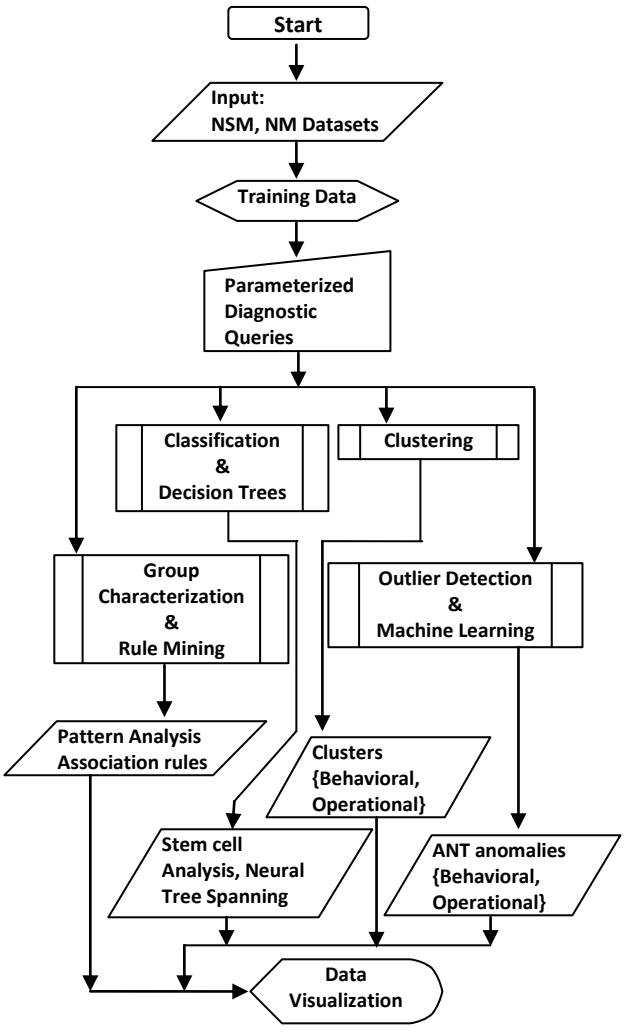

Figure 3. ANT Mining Process

4.2 Functional Algorithms of ANT

Table 3. ANT functional algorithms

Algorithm for ARM, GC

Input: Parameterized Query, NSM Training Set, NM Training Set
Output: FP-Trees, ARM Rules

```
Begin
    Switch(Parameter)
{
Case  PA: Generate ARMs for patients mental
          behavior, functional neuron
          Structures and metrics
Case  DA: Generate Arms for disorder organs
          and their behavior  from diagnostic
          statistics
}
end
```

Algorithm for D-Trees

Input: Parameterized Query, NSM Training Set, NM Training Set
Output: Decision Trees, Induction Rules, Spanning Trees of Stem Cells

```
Begin
    Switch(Parameter)
    {
     Case  PA: Classification of patients,
               generating decision trees neuron
               Structures and metrics with
               classifiers
     Case  DA: Generate decision trees for medical
               diseases based on classification
               details, rule based Induction Trees
               to treatment recommendations
     }
End
```

Algorithm for Outlier-Analysis

Input: Parameterized Query, NSM Training Set, NM Training Set
Output: Outlier data

```
Begin
    Switch(Parameter)
    {
     Case  PA: Detection of outliers from patients
               mental behavior, Brain functioning
               disorder grading
     Case  DA: Detecting diagnostic report
               anomalies for neuron metrics to
               estimate rate of cell damage or rain
               structure defects
     }
End
```

Algorithm for Clustering

Input: Parameterized Query, NSM Training Set, NM Training Set
Output: Behavior clusters, Structure clusters, Cell telematic clusters

```
Begin
    Switch(Parameter)
    {
     Case  PA: Generates Clusters for patient
               Behavior, cell structure statistics
     Case  DA: Generate Clusters for diagnostic
               Reports to analyze disorder zone
               Wise. Clusters for  neuron metrics to
```

```
                    estimate the density of active cells
                    over Brain structure
        }
End
```

The data mining functionalities supported by ANT mining process algorithmically described in Table 3. All the functions commonly depend on NSM and NM data sets input and generate output in various statistical forms supported by data mining tool associated with architecture. The parameters are enclosed in a short form assembled query format as defined below

[Query-Format]

[DM_ACT] on [TRAIN_SET] based on [DM_PARAM] to generate [DM_VISUAL {Graph| Statistics| Data}

CONCLUSION

The architecture introduced in this paper needs tightly coupled interfaces among medical equipment, data synthesizers and data mining third party tool. A significant effort needed to bring this architecture into working software model. In future this architecture layout would act as foundation to ANT Miner software tool design using Java technology. The model designed in this paper aimed to increase the accuracy of diagnostic surveys and support doctors to analyze neural networks of patient's brain more efficiently over both online and offline functionalities.

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