

Chapter 43

Intelligent Models to Predict the Prognosis of Premature Neonates According to Their EEG Signals

Yasser Al Hajjar

Angers University, Angers, France

Abd El Salam Ahmad Al Hajjar

Lebanese University, Saida, Lebanon

Bassam Daya

Lebanese University, Saida, Lebanon

Pierre Chauvet

Angers University, Angers, France

ABSTRACT

The aim of this paper is to find the best intelligent model that allows predicting the future of premature newborns according to their electroencephalogram (EEG). EEG is a signal that measures the electrical activity of the brain. In this paper, the authors used a dataset of 397 EEG records detected at birth of premature newborns and their classification by doctors two years later: normal, sick or risky. They executed machine learning on this dataset using several intelligent models such as multiple linear regression, linear discriminant analysis, artificial neural network and decision tree. They used 14 parameters concerning characteristics extracted from EEG records that affect the prognosis of the newborn. Then, they presented a complete comparative study between these models in order to find who gives best results. Finally, they found that decision tree gave best result with performance of 100% for sick records, 76.9% for risky and 69.1% for normal ones.

DOI: 10.4018/978-1-7998-2460-2.ch043

1. INTRODUCTION

A premature baby is physiologically vulnerable to have neuro-developmental problems according to his gestational age. The electroencephalogram (EEG) is the most often used criterion in predicting this risk. Electroencephalography (EEG) is a neurological diagnosis that measures the electrical activity of the brain via electrodes (usually 10-20 system) placed on the scalp. They are distributed symmetrically on both hemispheres with respect to the frontal regions, occipital and temporal (Wikström, 2011). In the newborn case, 9 electrodes are enough (Koolen et al., 2013). The place of the electrode can cause an artifact in the EEG recordings such as traces caused by the activity of the heart that can be detected in ECG (electrocardiogram) or traces caused by the activity of the eye that can be detected in EOG (electro-oculogram) (Mizrahi, 2007). An EEG is requested when there are abnormalities in neurological status such as brain dysfunction. It determines the presence of brain injury as well as neonatal seizures. For example, an EEG should be done to diagnose unexplained apnea, flushing of the face as well as the neurological status lethargic or hyperactive (Lombroso, 1985; Wikström, 2011). Normal neonatal EEG determines normal brain development and progress. Abnormalities can be detected by specific patterns such as continuity, waveform and wake-sleep cycle. There are gradual variations from discontinuity to continuity (Mizrahi, 2007). Continuity appears in wakefulness and discontinuity appears in sleep. There are many waveform definitions such as Beta, delta theta and alpha that can be considered normal according to the gestational age of the newborn. Awake EEG and active sleep shows a continuous trace consisting of mixed frequencies.

The first step of our work is to extract from the EEG signal features that are related to the prognosis of the premature newborn. We used an application called EEGDiag (Chauvet and Nguyen, 2013), which segments the EEG signal in phases of burst and inter-burst intervals (IBI) and detects in each phase features useful in predicting neuro-developmental risk. These features are presented by 14 parameters. We used a data set of 397 premature newborns, collected in Angers hospital, having each his EEG at birth and his diagnosis two years later, which is classified into: normal, sick or risky (risky means that it was not clear yet if the newborn will be sick or not). Detecting these 14 parameters in the 397 EEG recordings, we obtained a dataset that contains 397 feature vectors, each one has 14 inputs and one output which is normal, sick or risky. Then, we executed machine learning using one of the most popular intelligent models (multiple linear regression, linear discriminant analysis, artificial neural network and decision tree) to generate the best intelligent classification system that determines the prognosis (normal, sick or risky) of a premature new born according to the 14 inputs detected in his EEG signal at birth (Wu et al., 2008). In this work, we used 80% of the dataset for training and 20% for test to specify the performance of the found system by comparing its result with that given by doctors.

In the next section of this paper, we define EEG features that affect the prognosis of the newborn. In section 3, we present the dataset used in machine learning. In section 4, we execute machine learning by applying the 4 intelligent models: linear discriminant analysis, multiple linear regressions, artificial neural network and decision tree and we present their results. In section 5, we discuss a complete comparative study between the 4 intelligent models, to evaluate the performance of each one. In the final section, we present the conclusion and perspective of this work.

9 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/intelligent-models-to-predict-the-prognosis-of-premature-neonates-according-to-their-eeeg-signals/252059

Related Content

Priming

Christina Bermeitinger (2015). *Exploring Implicit Cognition: Learning, Memory, and Social Cognitive Processes* (pp. 16-60).

www.irma-international.org/chapter/priming/120852

Re-Echoing the Scream: Rod Dickinson's Shock Machine and the Re-Emergence of Milgram's "Obedience to Authority" Experiments

Bernadette Buckley (2024). *Performativity and the Representation of Memory: Resignification, Appropriation, and Embodiment* (pp. 121-148).

www.irma-international.org/chapter/re-echoing-the-scream/354721

Classification of Sentiment of Reviews using Supervised Machine Learning Techniques

Abinash Tripathy and Santanu Kumar Rath (2020). *Cognitive Analytics: Concepts, Methodologies, Tools, and Applications* (pp. 143-163).

www.irma-international.org/chapter/classification-of-sentiment-of-reviews-using-supervised-machine-learning-techniques/252024

Empirical Evaluations of Interactive Systems in Cultural Heritage: A Review

Panayiotis Koutsabasis (2020). *Cognitive Analytics: Concepts, Methodologies, Tools, and Applications* (pp. 1331-1355).

www.irma-international.org/chapter/empirical-evaluations-of-interactive-systems-in-cultural-heritage/252084

Speaker Recognition With Normal and Telephonic Assamese Speech Using I-Vector and Learning-Based Classifier

Mridusmita Sharma, Rituraj Kaushik and Kandarpa Kumar Sarma (2020). *Cognitive Analytics: Concepts, Methodologies, Tools, and Applications* (pp. 805-829).

www.irma-international.org/chapter/speaker-recognition-with-normal-and-telephonic-assamese-speech-using-i-vector-and-learning-based-classifier/252058