NEUROBELL.AI: RETHINKING EEG ANALYSIS THROUGH AI AND SONIFICATION

Fosters inclusivity, accessibility and feasibility for all patients

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IEEE/SA-Rethink the Machine competition
- Oxygen deprivation at birth leads to brain injury and 80% of seizures
- 1-3.5/1000 live births affected
- <10% of seizures detected through clinical signs
- >2.5 Million births affected Worldwide/Year
- > 1 million deaths or disabilities
- Low/middle-income countries disproportionately affected

- EEG Analysis is the gold standard
- Severe shortage of trained medical professionals for EEG analysis
- Even if available, not operating 24/7
Delay in diagnosis leads to increased morbidity and mortality
ISSUES IDENTIFIED

- Lack of trained personnel
- Analysis taking long (>1/7th of the EEG recording)
- Report very late >24h
- Costly equipment
- Lack of IT infrastructure
- Power outages,...

Some System Specification:
- Have fast response time;
- Be accurate;
- Be easy to use and allow for quick review;
- Enable better monitoring and care in real-time in a remote location;
- Be low-cost, battery-operated, and plug and play.

(J. Brogger et al Visual EEG reviewing times with SCORE EEG, 2018)
PROPOSED SOLUTION

Neurobell.AI EEG analysis anytime, anywhere needed, pervasive to medical professionals

- Scalable and interoperable
- Adaptable and flexible
- Expandable

Why sonification?

- Seizures evolve over time, the human ear is the most natural tool to sense that

Review time less than 5s for an epoch of 2h; Accuracy on par with experts
PROOF OF CONCEPT

AI+Sonification
For seizure detection

Edge/IoT

Mobile

Cloud

Secure HW

Secure SW

Early warning system (always on AI)

Ultra-fast, accurate review

https://sites.google.com/view/neurobell-ai/home

Maxim Integrated AI Contest: 1st prize, 2021 (project on security and AI)
2 HOURS OF EEG = 360-720WINDOWS TO SCROLL

- 22M EEG values in one day
- Seizures are rare events (once in many hours)
- Seizures can be as short as 10s
  - 1/7 to 1/2 of the recording time required for review
DEMO 1: 2 HOURS OF EEG ANALYSED IN 3 SECONDS

- AI allows an early warning
- AI allows identifying interesting segments, helps focusing attention
- 144h required to review 1 week-long EEG (6 babies) recording by an expert
- 0.6h required to review 1 week-long EEG (6 babies) recording by a non-expert medical professional

Seizure: high pitched sounds
DEMO2: 2 HOURS OF BACKGROUND EEG IN 2 SECONDS

No seizures: quiet crackling, popping or hissing sounds
WANT TO LEARN MORE: AI-DRIVEN EEG SONIFICATION SURVEY/DEMO/PAPER

https://sergigomezquintana.github.io/EEGsoundSurvey/

Send us your own full demo/survey results to E.Popovici@UCC.IE

A Method for AI-Assisted Human Interpretation of Biological Signals: Analysis of Neonatal EEG, 2022, Nature Scientific Reports, under review,
https://www.researchsquare.com/article/rs-1232994/v1
VALUE PROPOSITION

A new explainable AI methodology to augment human natural senses

100-1000 times faster review than visual analysis; With NO accuracy loss; With no training

Expandable concept for the interpretation of biological signals
THANK YOU!

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Selected Publications: