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| **AutoEEG: EEG Analytics From Big Data** Contact: Iyad Obeid1947 North 12th Street, Philadelphia, Pennsylvania 191222 Email: iobeid@gmail.com; Tel: (215) 360-9392 |
| **Core Team:*****Iyad Obeid, PhD****, Co-Founder, Technical Leader** Professor of Electrical and Bioengineering, Temple Univ.
* Over 15 years of experience in bioengineering and neuroscience
* PhD, Biomedical Engineering, Duke University
* MEng, BS, Electrical and Computer Engineering, MIT

***Joseph Picone, PhD****, Co-Founder, Technical Leader** Professor of Electrical and Comp. Engineering, Temple University
* Over 30 years experience in machine learning and big data
* PhD, MS, BS, Elect. Eng., IIT

***Mercedes Jacobson,*** *MD, Clinical Neurologist and Consultant** Professor, Neurology, Temple University School of Medicine;
* Over 30 years experience in neuroscience
* Board certified EEG specialist; Director of the TUH EEG Lab.
* MD, Columbia University College of Physicians and Surgeons
* Fellowship, University of Pennsylvania School of Medicine

**Project History:*** Research initiated in 2011 under DARPA and NSF funding to harden clinical solutions through the use of big data.
* To be incorporated in 2015.
* Initial financing of $110K from University City Science Center, both cash and in-kind.
* Inventors seeking further development funding or a sale or license of their invention.

**Pro Forma FinancialRequirements ($M USD):**

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|  | 2015 | 2016 | 2017 |
| *Direct* | $0.6 | $0.9 | $1.3 |
| *Indirect* | 0.3 | 0.4 | 0.5 |
| *Total* | $0.9 | $1.3 | $1.8 |

 **Accomplishments to Date:*** Trained on the world’s largest clinical EEG database (25,000+ EEGs spanning 12 years at TUH)
* Automatic identification of EEG events such as spikes, GPEDs, PLEDs to enhance reporting
* Cross-platform software tools that enable rapid development of analytics and visualization
 | **Overview:** A university-based research team, comprising world-known experts in computer science, biomedical engineering as well as in neurology, has identified a substantial market opportunity for *AutoEEGTM*, a product of their work focused on neural signal processing using Big Data. This distinctive software tool autoscans electroencephalogram (EEG) signals and directs a neurologist’s attention to areas of the signal critical to a diagnosis. EEGs are the most pervasive neural diagnostic tool; they require a highly trained neurologist to analyze them. This analysis is time consuming and expensive. *AutoEEGTM*enhances productivity by autoscanning EEG signals and flagging sections of the signal that need further review by a clinician. The tool reduces the amount of data needing manual review by two orders of magnitude, offering substantial productivity gains in a clinical setting. Developed by an interdisciplinary team of Temple University researchers, *AutoEEGTM*, addresses three critical industry issues: * Long-term EEG monitoring (2 hours+), used to diagnose rare events such as epileptic seizures, is difficult or impossible to scan manually without decision software support.
* Development of portable standalone diagnostic tools, which can address emerging markets such as contact sports, is highly difficult.
* Smaller or stand alone medical practices often lack expertise to conduct diagnostics on-site and accordingly lose revenue.

At present, innovation in commercial clinical decision support tool development is minimal, while the global market for rapidly diagnosing brain-related injury and disease is growing. The global brain function monitoring market is currently ~ $1.1B (2014) and expected to average 5% growth/year over the next 5 years, to reach ~$1.5B in 2019. Asia Pacific represents the fastest growing regional market with 9% CAGR over the same period.**Product Summary:** This clinical decision support tool is based on proven, advanced, deep learning technology. It reduces time to diagnosis, reduces error and is sufficiently lightweight to run on portable standalone platforms. This technology is able to identify EEG events in the signal and subsequently to provide a report that summarizes its findings based on the event detected. The transcribed EEG signals can be viewed from any portable computing device. It also has the ability to learn from data, helping in future decision making, providing real-time feedback to aid in diagnosis, and, for patients undergoing long-term monitoring, creating an alert when abnormal signals are identified. This market leading product will* Enable clinical neurologists employing a volume-based business mode to decrease the time spent analyzing an EEG and thereby increase billing.
* Allow pharmas to assess changes quantitatively in neural activation during clinical trials.
* Allow neurologists to order and bill for substantially more long-term monitoring tests based on this proven decision support tool.
* Add value to the commodity EEG headsets currently entering the market by providing meaningful, real-time signal analysis.

Products which make similar claims are based on outdated signal processing methods, were trained using small, proprietary datasets and rely on ad hoc, heuristic rules. As a result, such competing products are not used by neurologists in clinical settings.*AutoEEGTM* is based on technology that has been successful in a wide range of signal processing applications (e.g., speech recognition). Emerging markets beyond traditional EEG clinical applications include chronic traumatic encephalopathy (e.g., sports-related head injuries and post-traumatic stress disorder), sleep disorders and Alzheimer’s disease. This technology also enables real-time event detection for ambulatory EEG applications.**Uses of Funds:**The product requires $2.2M in funding over the next two years for research and development necessary for commercialization. The project will consist of three phases*Phase I (75% Complete)** Software Layer One to detect spikes of interest in the EEG within 95% accuracy
* Graphical front end software to facilitate customer demonstrations.
* Collection of user requirements, including feedback on spike detection accuracy.

*Phase 2 (2015Q1 – 2015Q4)** Software Layer Two based on deep learning to suggest diagnoses (5% complete).
* Expand alpha testing to multiple sites and initiate beta testing as customer sites.
* Address cross-platform development and run-time efficiency.

*Phase 3 (2016Q1 – 2017Q2)** Create production software that supports all major computing platforms.
* Refactor code for run-time efficiency and vendor integration.
* Develop mobile platform support based on customer needs.
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