**…open with the NEDC standard PowerPoint title slide… fade into the demo…**

**Introduction**:

Real-time computer assisted monitoring of electroencephalograms can improve the quality and efficiency of a physician’s diagnostic capabilities. The ability to rapidly detect and interpret seizures can reduce patient morbidity and mortality. In this video, we demonstrate our real-time seizure detection technology that uses state of the art deep learning technology to detect and localize seizure events. This software gives the user the ability to view the confidence for either seizure or background events directly over the signal display. Results can be stored and viewed offline for further analysis.

**Modules**: (show these as part of an overall block diagram with boxes and arrows, much like we use in our posters and proposals)

The software consists of five sequential modules: signal preprocessor, feature extraction, event decoding, postprocessing and visualization.

**Signal Preprocessor:**

The first step in the signal analysis is to apply a temporal central parasagittal, or TCP, montage to the EEG signal to accentuate seizure events. This enhanced multichannel signal data is then passed to the feature extraction module where it is converted to a time frequency representation suitable for application of our machine learning technology,

**Feature Extraction:**

In the second step of signal analysis, we use a sliding window approach to convert the signal to a sequence of feature vectors that capture the evolution of signal’s frequency content. Our feature vectors consist of a 26-dimensional representation that uses linear frequency cepstral coefficients to model frequency information and derivatives to model the temporal evolution of the signal. Features are computed 10 times per second.

**Event Decoding:**

The third step in signal analysis consists of an event decoder that uses a channel-based long short-term memory, or LSTM, and a hybrid LSTM/convolutional network network, or CNN, to generate a hypothesis for each second of the incoming EEG data. This model produces a seizure event probability and a corresponding background event probability.

**Postprocessor:**

The postprocessor accepts the seizure and background probabilities and uses predetermined duration and confidence threshold filters to produce an overall label and confidence value for each second of data.

**Visualizer**:

The visualizer shows the EEG signal for all channels as soon as the first module begins streaming. Once the detections are extracted and postprocessed, the visualizer labels and color codes each second of data. It uses SEIZ or BCKG (Spell during narration) labels and shows the color red for seizure or green for background. It also shows the overall confidence of an event. Events detected as a seizure are available approximately 15 secs after the event has actually occurred.

**Offline Analysis:**

The software produces an XML file that contains the results of the analysis. Events are labeled by type and include a start and stop time as well as a confidence.

After the system finishises streaming the signal and predictions, the user is able to use the scoll bar located at the bottom of the interface to scroll back and forth to any part of the file. An offline analysis can also be performed using a wide range of visualization tools to aide interpretation that include energy and spectrogram displays. (Show this using the annotator tool if the demo doesn’t have it.)

**Benefits:**

The ability to rapidly detect and interpret seizures and other brain abnormalities in critical care settings can reduce patient morbidity and mortality without significant additional costs of care. Continuous EEG, or cEEG, monitoring plays a vital role in these critical care settings because it supports clinical decision-making for modifying antiepileptic drug regimens and optimization of cerebral perfusion to help prevent secondary injury. Seizures, especially non-convulsive seizures, may not be evident by observational examination alone.

The use of cEEG in the ICU has been limited to settings where there are sufficient skilled personnel to provide 24/7 monitoring of the results. A nationwide analysis of the use of cEEG indicated that its use was mainly limited to a small percentage of leading level one trauma care teaching hospitals. Due to manpower and cost constraints, community hospital settings lack 24/7 neurologist coverage. The automated seizure detection tool presented in this video offers the potential to revolutionize healthcare in critical care settings by allowing clinicians to identify clinical changes rapidly and treat patients more safely and effectively.

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For more information about this technology, please contact the Neural Engineering Data Consortium located at Temple University, or technology development partner, Biosignal Analytics, Inc. If you are interested in the open source data and resources used to develop this technology, please visit our web site at *www.nedcdata.org*.