

Parallelization of Nonlinear Application Code

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http://wiki.ornl.gov/sites/rams/c_collins/Pages/default.aspx



Introduction

The objective of this study is parallelization of an existing research-class nonlinear analysis. Parallelization provides an infrastructure to start and run each instantiation of the FORTRAN implementation on separate nodes of the White Oak cluster computer. The infrastructure also returns all of the results in a single output file to the user. Multiple search engines were employed (such as Google, Ask Jeeves, Yahoo, and Livesearch) to research programs, commands, and other scientific processes to gather information needed for creation of the software. The primary result was that the Java code successfully runs by executing independent instantiations of the FORTRAN on 65 nodes of the cluster and then returns the results to the user. It will then use the parallelized version to analyze brain wave data for seizure forewarning for various values of the statistical parameters. The goal is maximization of the total true rate, which is the sum of true positives (correct prediction of a seizure event) and true negatives (no forewarning when no event occurs). This will be used to create an device that forewarns the user of a possible seizure that may occur within the next couple of hours.

Background

- Nonlinear approach that indicates condition change in experimental data has been developed and patented
- “R&D Magazine” awarded its prestigious R&D100 Award in 2005 to SeizAlert technology which is
 - Low-cost
 - Compact
 - Prototype PDA device to alert the wearer and medical personnel of an impending epileptic seizure

Research Objectives

- Convert the existing research-class, nonlinear statistical FORTRAN code to a parallelized form
- Analyze brain wave data for seizure forewarning for various values of the statistical parameters
- Find a parameter set that maximizes the total true rate

Methods

- Determined software requirements
- Used Eclipse- software for creating and running the Java Code
- Used FileZila- software for transferring files across a network
- Used Putty- software to login onto the White Oak cluster to run and compile the Java Code
- Used ArgoUML- software to draw the diagrams of how the program was going to run
- Wrote the java code that parallelized the FORTRAN code from scratch using different sources

The Process of the SeizAlert

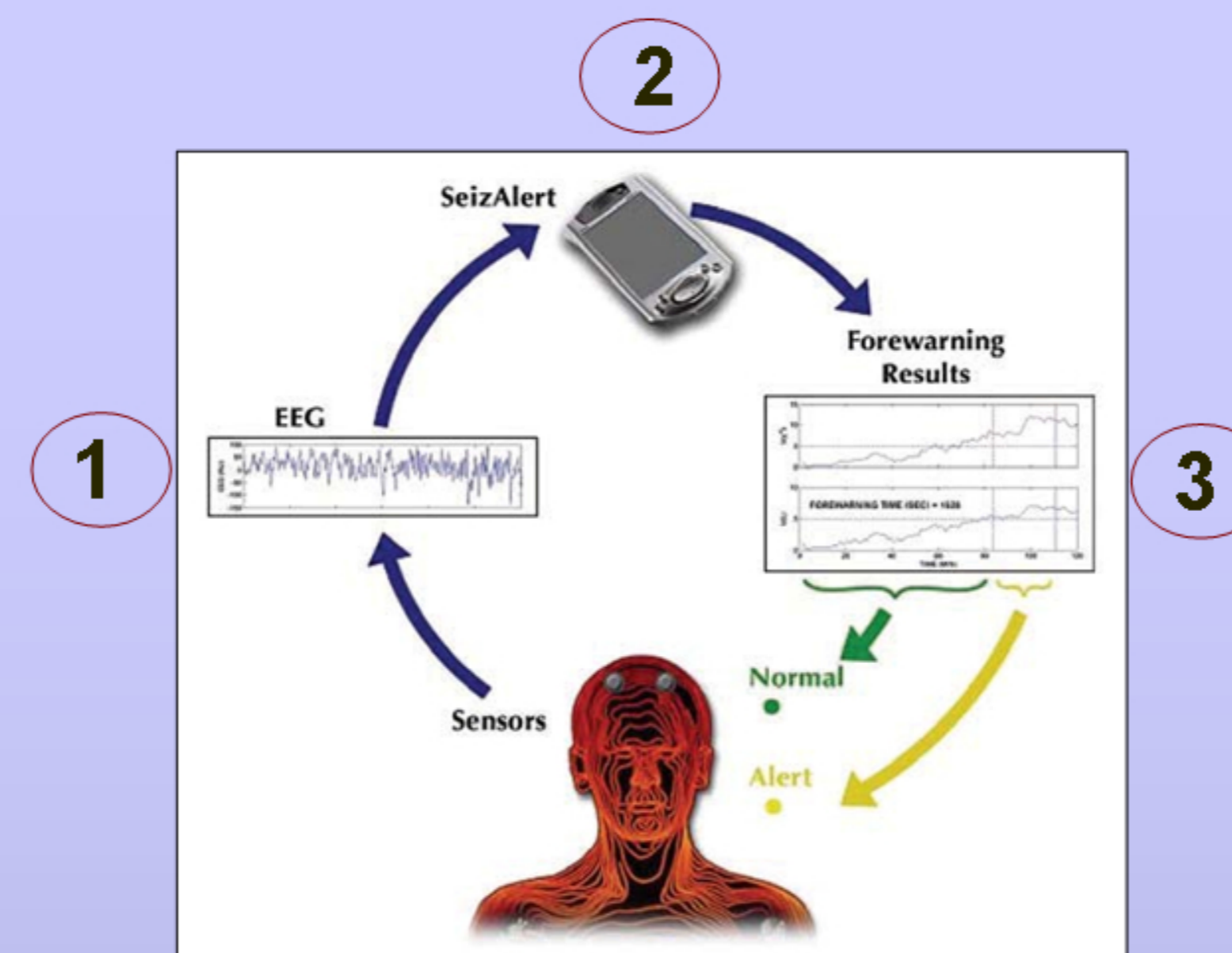


Fig.1. SeizAlert seizure prediction process

1. EEG data gathered and sent to SeizAlert device
2. Artifact removal done and discrete points generated
3. Analysis of dissimilarity
4. Forewarning result

Conclusions

- FORTRAN code runs successfully on a number of nodes on the cluster
- Capability will allow rapid and precise identifications of better parameters
- Will also be used for other forewarning applications
 - Biomedical
 - Industrial applications
 - Complex structures

Future Research

- Other biomedical examples
 - Detection of sepsis onset from ECG
 - Breathing difficulty from surface chest sounds
- Industrial applications provide forewarning of machine failures from motor power to tri-axial acceleration
- Related novel application is forewarning of failure in complex structures, such as bridges and cranes

