From BIOPATTERN to Bioprofiling over Grid for e-Healthcare

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Outline of the talk

• Introduction
  – The BIOPATTERN project
  – Grand Vision
• Biopattern and Bioprofile
• Why over Grid?
• BIOPATTERN Grid
  – Prototype and services
  – An illustrative example
• Concluding remarks and future work
The BIOPATTERN Project

- EU FP6, 4-year, Network of Excellence (NoE), project within the ICT for Health
- Involves 30 partners from healthcare, academia and industry.
- Brings together researchers in medical informatics, bioinformatics, biosignal analysis and e-delivery technology
- Partners are from 11 countries
- More information at http://www.biopattern.org
BIOAPPTTERN – Grand Vision

- “To integrate co-operative research aimed at a pan-European approach to coherent and intelligent analysis of a citizen’s bioprofile; to make the analysis of this bioprofile remotely accessible to patients and clinicians; and to exploit the bioprofile information to combat major disease classes”.

- Vision is long term, but it inspires short term objectives.
Biopattern and Bioprofile – what are they?

• Biopattern – basic information which provides clues about underlying clinical evidence for diagnosis and treatment.
  – A snapshot which includes features derived from data (e.g. genomics, EEG, ECG, imaging etc);
  – Often used for diagnosis and short-term patient monitoring

• Bioprofile – personal ‘fingerprint’ that combines a person’s bio-history and future prognosis.
  – Combines not only data, but also analysis and predictions of possible susceptibility to diseases.
  – Should drive personalised and better healthcare.
Some of the key areas in BIOPATTERN

- Bioprofiling for early detection and care for Alzheimer’s disease.
- Early Life – fetal and neonatal bioprofiling assessing adverse events and their impact.
- Personalised care for breast cancer
- Personalised care for Leukaemia (in collaboration with GEMIMA Project)
- Personalised care for brain tumour (in collaboration with eTumour project).
Concept of bioprofiling – timeline

**Conception** (Geneology; Maternal Health; Environment)

**Neonatal assessment**
(EEG; Other) + STEM cell samples; blood samples

**Birth**
Obstetric Data (HR; ECG; BG)

**Childhood Health Records & Demographics**
{Recordings from operative Procedures
Weight; Height; Diet; Activity; Medication;
Environment; Social-economic data; Injuries}

**Childhood and adolescence**
Developmental Data
{EEG; EP; psycometric tests}

**Early adult years**
(Onset of personality disorders such as Schizophrenia)

**Post 65** At risk group for degenerative disease (e.g. dementia) and cancer
EEG, MRI

**Death**
Certificate & Post mortem
Why over Grid?

- Conceptually, our interest is in “bioprofiling from birth to death”
- Bioprofiling databases are geographically distributed.
  - Mobility of a citizen (e.g. Mike’s life journey)
  - Databases may be located at different countries/centres.
  - Collaboration and cooperation with partners across the EU, need sharing of resources (e.g. expertise, data and software/algorithms).
Why over Grid? (cont)

- Bioprofiling databases are huge, dynamic and distributed.
  - Databases are huge (e.g. serial MRI, EEG etc.)
  - Databases are dynamic (update of data at any time)
- Intelligent analysis of a huge database are computation intensive
  - For analysis of imaging data (e.g. MRI and CT)
  - For visualisation of large medical data set
  - For integration and fusion of data
Bioprofile over Grid – prototype

Diagram showing the integration of various components such as Bioprofile database, Grid nodes (Globus), Alumni pool, Condor pool, Web server (Grid Portal), and User Interface through the Internet and various networks including WLAN and Condor pool.
BIOPATTERN Grid services

• **High Level Services**: for end users to use grid-enabled services via the BIOPATTERN grid portal

**BIOPATTERN Grid Portal**

- Welcome to the BIOPATTREN Grid Portal

**Grid/Web Services:**
- Data upload/update
- Data query
- Data analysis

If you encounter any problems, please email to [Pin Hu](mailto:Pin.Hu) for technical support.

Feedbacks and Comments are welcome!

Last updated 13/02/2004 to [Pin Hu](mailto:Pin.Hu), SPMC, SoCCE, University of Plymouth.
BIOPATTERN Grid services (cont.)

• Low level (Grid level) services
  – For users to directly access grid resources
  – Services accessed via Globus containers
  – Data services
    (e.g. Remote data acquisition, which offers automated data acquisition, management and exchange )
  – Computational services
    (e.g. Crawling service, which provides a generic search engine to collect relevant specific documents, data etc.)
  – Management services
    (e.g. Workflow substitution and management services)
An illustrated example – bioprofile over grid for dementia

Dementia is a progressive, age-related neurodegenerative disorder associated with cognitive decline and aging.

It is common in the elderly. 10% of persons over age 65 and up to 50% over age 85 have dementia.
Detection of dementia by use of a biomarker derived from analysis of EEG

Index

Onset of disease

Index is abnormal

Normal spread

Time (s)
EEG analysis for early detection of dementia

User GUI

Clinical info query Interface

Query classes

Web services

EEG analysis interface

Analysis classes

Grid services

Analysis result display interface

Result display classes

Grid middleware

Workflow management services

Query services

Fractal dimension analysis service

OGSADAI data services

Execution management services

Zero crossing analysis service

Grid resources

OGSADAI-WSRF

GT4 core

WS-GRAM

Bioprofile databases

Algorithm databases

Condoor pool

Globus-based computational resources

Data resources

Computational resources

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Data Update/Upload Service

BIOPATTERN Grid Portal

Clinical Information Update/Upload

The Clinical information update service is for and users to update patients' information based on distributed data resources in order to match the concept of bioinforming.

If you have a new patient, please click the button below to add a new patient and his/her EEG data files.

Add a new patient and his/her EEG files

If you have an existing patient, please click the button below to add new EEG files to this patient.

Add new EEG files to an existing patient

Screenshot 1: Clinical information update/upload

Upload EEG files of the patient

Browse...

Browse...

Browse...

Uploaded Back

Screenshot 2: Uploading EEG files
Data Query Service

Screenshot 3: Log on screen

Screenshot 4: Data Query

Screenshot 5: Patient Select

Please select one of the following patients, and click the "Check to view the patient's EEG data files" button to check the corresponding EEG files of the patient:

<table>
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<tr>
<th>ID</th>
<th>First Name</th>
<th>Middle &amp; Last Name</th>
<th>Date of Birth</th>
<th>Gender</th>
<th>Weight</th>
<th>Height</th>
<th>Ethnic Origin</th>
<th>City Origin</th>
<th>Country Origin</th>
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<th>Country of Resident</th>
<th>Nationality</th>
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<td>Thompson</td>
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<td>M</td>
<td>87</td>
<td>182</td>
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<td>Plymouth</td>
<td>England</td>
<td>India</td>
<td>Calcutta</td>
<td>English</td>
</tr>
<tr>
<td>25</td>
<td>Mark</td>
<td>Thompson</td>
<td>1915-07-01</td>
<td>M</td>
<td>77</td>
<td>180</td>
<td>European</td>
<td>Plymouth</td>
<td>England</td>
<td>Germany</td>
<td>Frankfurt</td>
<td>English</td>
</tr>
</tbody>
</table>

Nationality: 
- English
- Indian
- Calcutta
- English
- Suspicious
Data Analysis Service

BIOPATTERN Grid Portal

Please select any of the EEG files of the patient presented below, and click the "Analysis" button to analyse the EEG files you want.

- Subject1 EEG
- Subject2 EEG

Screenshot 6: EEG files of patient selected for analysis

<table>
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<tr>
<th>AllBarF</th>
<th>ALL</th>
<th>Fp1</th>
<th>Fp2</th>
<th>F7</th>
<th>F3</th>
<th>F2</th>
<th>F4</th>
<th>P8</th>
<th>a1</th>
<th>T3</th>
<th>C3</th>
<th>CZ</th>
<th>C4</th>
<th>T4</th>
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<td>1.371960</td>
<td>1.364821</td>
<td>1.363472</td>
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<td>1.327207</td>
<td>1.340599</td>
<td>1.313018</td>
<td>1.374012</td>
<td>1.381172</td>
<td>1.362020</td>
<td>1.340559</td>
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<td>1.250014</td>
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</tr>
</tbody>
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Screenshot 7: Analysis results - Fractal dimension of selected EEGs
Data Analysis Service – Viewing results

Screenshot 8: Cannonogram showing distribution of results

Screenshot 9: Bargraphs showing distribution of results
Concluding remarks and future work

• Ongoing project
  – An integrated data, computation and knowledge grid environment
  – More and enhanced grid applications and services to support Bioprofiling (brain diseases and cancers)
  – Enhanced portal

• Move from research prototype to clinical prototype
  – Ethical and regulatory issues
  – Privacy, security and QoS issues
  – Scalability issues
  – Develop links with large Grid projects (e.g. EGEE, NGS, OMII)