

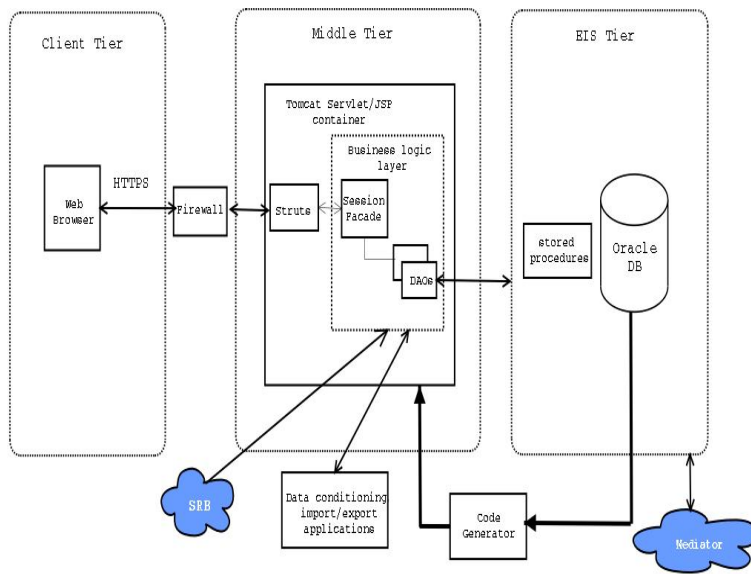
A GENERAL, EXTENSIBLE SYSTEM FOR HUMAN BRAIN IMAGING DATA RETRIEVAL AND MAINTENANCE

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The proposed architecture is based on three tier Java 2 Enterprise Edition (J2EE) architecture and illustrated in Figure 1. It consists of a thin client tier, a servlet/JSP based middle tier and a relational database based enterprise information source (EIS) tier. The client tier consists of a web browser. The EIS tier consists of an Oracle database and a collection of stored procedures/packages for low level data access functions and to optimize hot spot queries. The middle tier decouples presentation logic, i.e. code preparing data to be present to the user, and business logic, the code manipulating human brain imaging and/or clinical data, which allows flexibility in presentation layer selection and facilitates parallel multi-person/multi-site development. The business logic layer is further modularized by using code generated Data Access Objects (DAO) , providing a data access layer for the underlying data source and decoupling the upstream layers from data source dependency. The DAOs provide create, find, update and delete operations on the data source level and are fine grained. The presentation layer communicates with the data access layer through session facades, which coordinate operations between multiple DAOs in a workflow and provide a coarse grained simpler interface hiding the internals of the business logic from the presentation layer. The data transfer between presentation and data access layer is done via coarse grained transfer objects. Each software layer communicates with neighbour layers via well defined interfaces, which remain stable while the actual implementation can change drastically over time facilitating software maintenance and robustness. The system interfaces with a federated, distributed file system for image data and with a heterogeneous data source integrator system (Mediator) to form a multi-site federated database. The architecture uses row level fine-granular database security based on Oracle Label Security allowing data with different levels of security requirements to reside in a single database.

The proposed system is used to maintain and query local human brain imaging databases for several morphometric and FIRST BIRN sites. The implementation uses Struts (<http://jakarta.apache.org/struts/>) as web framework and runs under Tomcat application server (<http://jakarta.apache.org/tomcat/>). The current version provides a generic clinical and/or derived data complex query builder, query result export for statistical analysis tools, MRI image preview, conversion and download, subject, visit and experiment management. About 60% of the source code is code generated from the database schema, allowing changes on the database schema to be reflected in the system easily. The local BIRN sites have slightly different database schemas reflecting their site specific needs and different data sets. The proposed architecture provides the extensibility, maintainability, security and parallel development features as demanded by the participating BIRN sites for building, accessing and maintaining their human brain imaging and related clinical data.



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