

HealthAgents

Agent-based Distributed Decision Support System for Brain Tumour Diagnosis and Prognosis

The **HealthAgents** project plans to create a multi-agent distributed **Decision Support System**, to help in the early diagnosis and prognosis of brain tumours. To reach this goal, a distributed **Data Warehouse** with the world's largest network of interconnected databases of clinical, histological, and molecular phenotype data of brain tumour patients will be created.

Objectives of the project

Brain tumours remain an important cause of morbidity and mortality in a large percentage of the European population. Diagnosis using Magnetic Resonance Imaging (MRI) is non-invasive, but only achieves 60-90% accuracy depending on the tumour type and grade. The current gold standard classification of brain tumours by biopsy and histopathological analysis involves invasive surgical procedure and incurs a risk of 1-2% morbidity.

The **HealthAgents** project will deliver an open and flexible, web-based framework that provides hospitals and other organisations world-wide, with a reliable tool to check and follow-up diagnostics of brain tumours in order to avoid invasive surgical procedures.

The main objectives of the project are:

- Improve the classification of brain tumours through multiagent decision support over a distributed network of local databases or Data Marts (DM).
- Develop new pattern recognition methods for a distributed classification and analysis of HRMAS and DNA data.

- Define a method to assess the quality and usability of a new candidate local database containing a set of new cases, based on a quality score.
- Compile, evaluate and use parameters to audit classifiers and improve them periodically.
- Create a "trust" framework to increase the amount of collaborating centres of the network.

"The HealthAgents project will create a user-friendly web-based distributed decision support system"

Project Description

The **HealthAgents** project aims to create a Distributed and multi-agent-based Data Warehouse (d-DWH), and an associated, distributed Decision Support System (d-DSS). This system will provide advanced distributed data mining func-

ionalities for analysis and interpretation of brain tumour data. The d-DWH will include the world's largest network of interconnected databases (Data Marts) of clinical, histological, and molecular phenotype data of brain tumour patients. The d-DSS will facilitate evidence-based clinical decision-making using MR and genetic based tumour classifications and will include new criteria from the automated analysis of each local database. The d-DSS will be deployed using the strictest security policies, granting confidentiality, authenticity and consistency of its information.

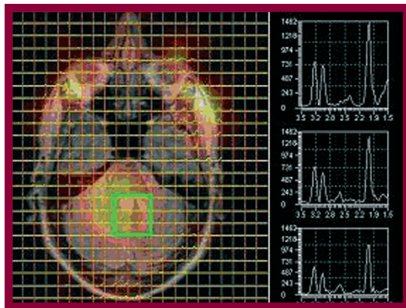
Scenario

There are many brain tumour types and grades (and other abnormal brain masses that may be confused with tumours by accessible in vivo diagnostic tools, e.g. multiple sclerosis). Use of metabonomics or survival data may further increase this (sub)type number. Developing robust classifiers may require 10-15 examples of each tumour (sub)type.

Assuming about 6,000 MRI/MRS centres and 100 cases stored per centre this provides a potential harvest field of 600,000 cases for classifier development. **HealthAgents** wants to set the basis strategies and protocols for this harvest to start and to demonstrate its feasibility.

The users of this system will include clinicians, histopathologists, epidemiologists, radiologists, neurosurgeons and statisticians within hospitals and cancer research institutions; pharmaceutical companies; and organisations with particular interest in data mining.

Agent technology and multi-agent systems will distribute and transfer data automatically and securely from and to any site through the network; upgrade and update the classification schemes; and invoke local and global classifiers from the local databases as well as from the virtual unified database (the d-DWH).



HealthAgents intends to lead the area of classification and non-invasive diagnosis and prognosis for patients with brain tumours. We envision the eventual formation of a “health-related” grid encompassing individuals committed to improving brain tumour diagnosis, enabling them to share resources,

architecture, clinical data, and information systems. This visionary grid will enable cooperation among researchers and clinicians across the continent. **HealthAgents** is being developed by a multidisciplinary European consortium. We are not aware of the availability of a similar system, and indeed such a consortium, anywhere else worldwide.

Expected Results & Impacts

The lifespan of the European population is increasing and accordingly, diseases that become prevalent in old age, such as brain tumours, will afflict a larger percentage of this population. In addition to this, within the younger population, cancer still remains the most common cause of death from disease in children over 1 year of age, and childhood brain tumours are the most common solid malignancies. As primary brain tumours are not known to have a lifestyle-associated aetiology, preventative strategies are not possible. Therefore, in order to maximise the quality of life and minimise healthcare costs, early and accurate diagnosis is required. This will enable optimal treatment planning, as well as facilitate the development of accurate methods to monitor treatment efficacy. This is a major goal of the **HealthAgents** project.

The **HealthAgents** project will create a user-friendly web-based distributed decision support system for clinicians, histopathologists, epidemiologists, radiologists, neurosurgeons and statisticians to provide easy access to the expert skills needed to analyse, display and interpret single tumour Magnetic Resonance Spectra, genomic and molecular imaging data from tumours. Particular attention will be paid to child brain tumours, which have a different aetiology and social impact when compared to adult brain tumours.

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- University of Edinburgh (UK)
- University of Southampton (UK)

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