

Neuroinformatics

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MITRE Sponsored Research

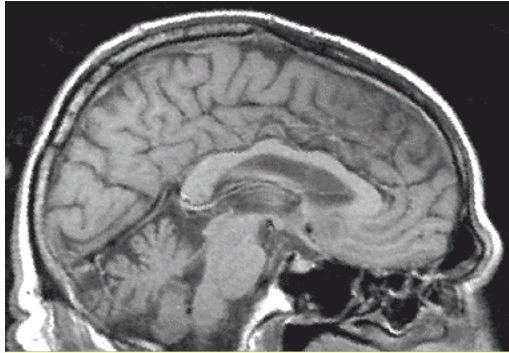


**MITRE
Technology
Program**

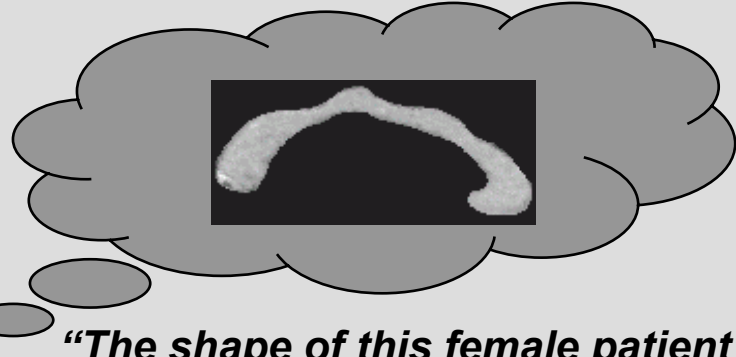
Problem

- **A vast amount of human brain mapping data is being collected without the infrastructure to organize the data to make it widely accessible and allow it to be used to its full potential.**
- **Furthermore, techniques for exploring and retrieving neuroimagery from databases are lacking.**

Background



**Female schizophrenic
subject 132**



“The shape of this female patient’s corpus callosum looks aberrant.”

“Could this be a general result?”

“Hypothesis: female schizophrenics have a structural abnormality in the corpus callosum”

Today, testing such a hypothesis would be a heroic effort requiring a large investment of financial and personnel resources to collect enough subject data.

Objective

- **The overall goal is to develop a secure information infrastructure to enable exploration, analysis, and dissemination of human brain mapping data.**
- **The research objective of this MSR is to develop the capability to query over features of the neuroimagery.**

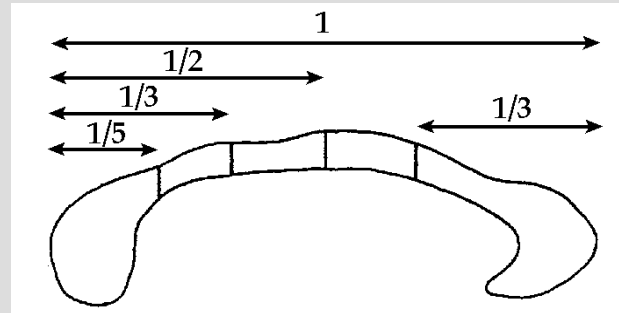
Activities

- **Design and prototype query modalities specific to the imagery: content-based retrieval (CBR)**
 - “find all images like...” (e.g., with a similarly shaped structure to the user-provided example)
 - combine with queries over metadata
- **Use data mining to link imagery and metadata**
 - correlate image characteristics with subject attributes
- **Apply machine learning to the CBR query engine**
 - learn feature relevance from commonly issued queries and migrate most frequently used features into standard attributes
- **Develop data quality metrics for MRI**
 - determine metrics intrinsic to the image and store as attributes that can be use to filter data

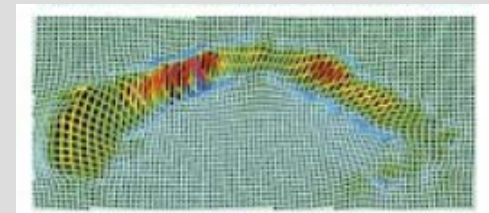
Highlight

Query Over Attributes of the Structure

Length, volume,
and spatial
relationships



Visualization



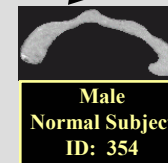
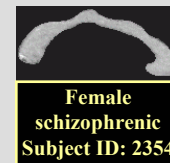
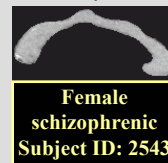
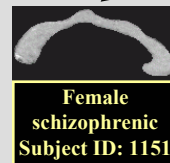
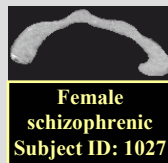
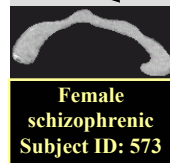
Query-by-Example

Search by providing
an example image



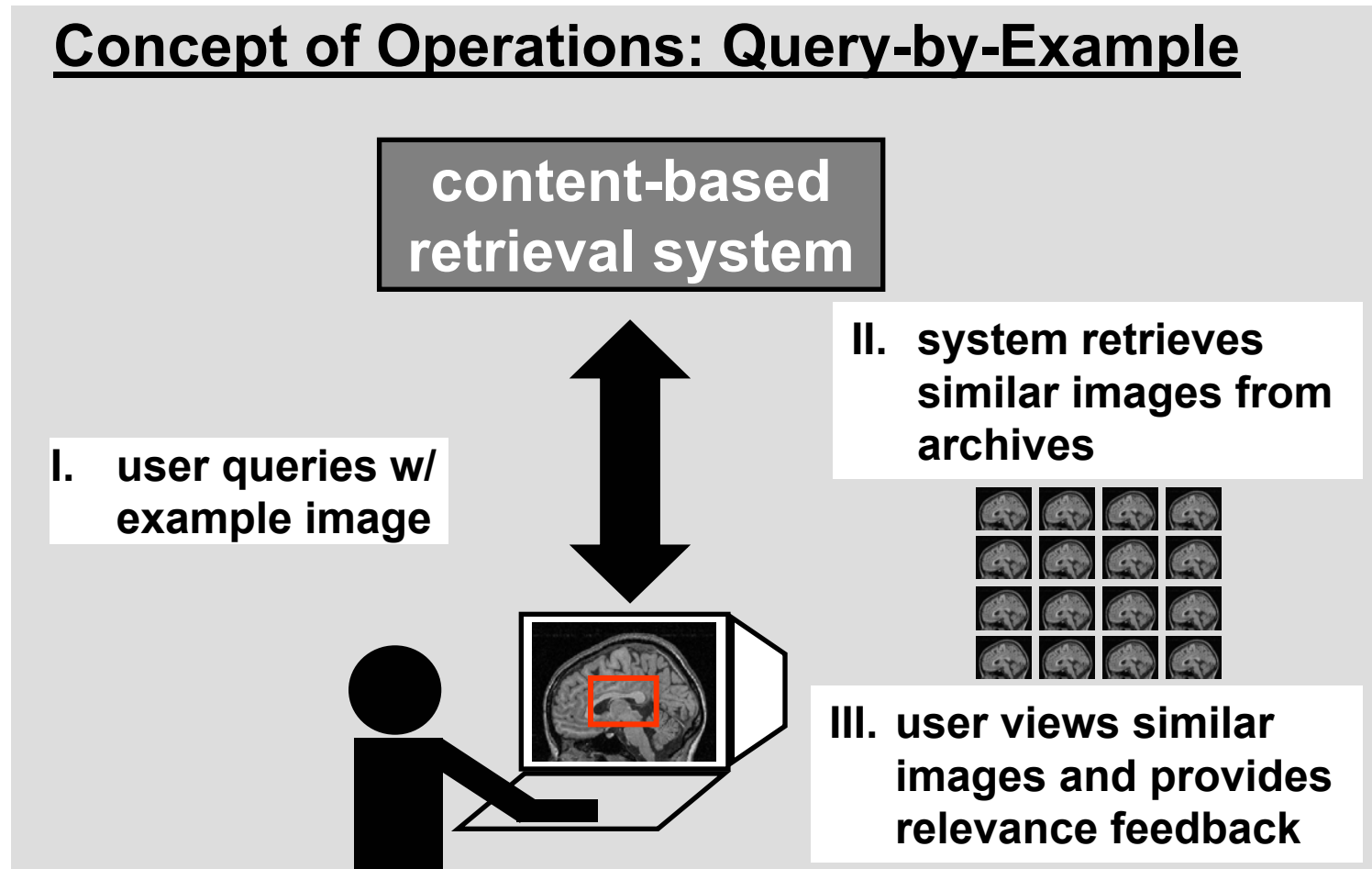
Female schizophrenic subject
132

Visualize differences
between the
schizophrenic patient
and a normal subject



Highlight

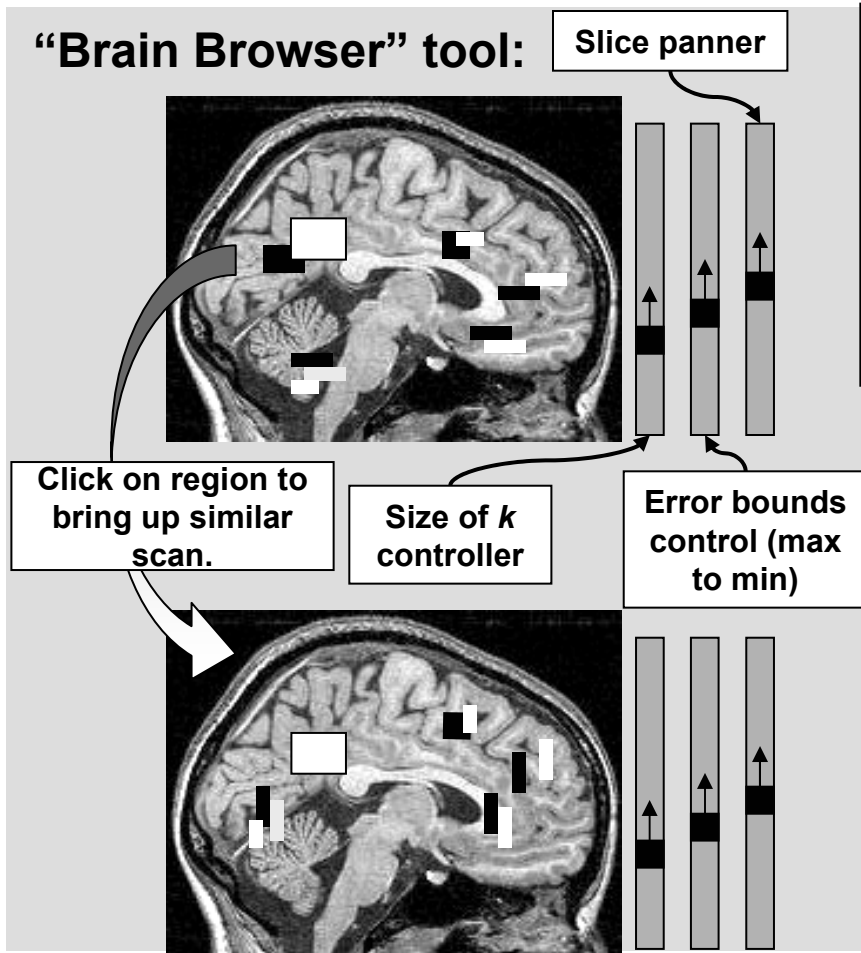
Concept of Operations: Query-by-Example



Impacts

- **Tools that will directly benefit the neuroscientific research community**
 - Enhancements to the MRI management platform developed under the NIMH/NSF grant
- **Applicability to other sponsors seeking to maximally exploit imagery (e.g., NIMA)**
- **Recognition in the scientific community through publishable research**
 - Iwerks, Glenn, “Continuous K-Nearest Neighbor Queries for Continuously Moving Points with Updates,” submitted to the 29th VLDB Conference, Berlin, Germany, 2003

Future Plans



What it will do:

For a given scan, show all regions for which the scan is the k Nearest Neighbor (kNN) of another subject's scan in a given demographic group.

Possible Extensions:

Browse for both kNN and all scans within some distance d .

Combine voxel intensities with other features (e.g., shape descriptors for a known brain structure)