

Utilizing NCBO Tools to Develop & Use an ECG Ontology

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The CardioVascular Research Grid (CVRG)

- CVRG = a ***community resource*** for the ***distributed management, semantic description, federation, and analysis*** of ***both primary and derived*** CV data
- CVRG is
 - * developing new CV-specific data management resources
 - * delivering CV data analysis tools and customized workflows
 - * creating easy to use, customized interfaces for accessing its resources
 - * providing these resources in a secure manner

Ontology Development:

Use & Extension of NCBO/NCI/BIRN Tools

- Strategy
 - * When applicable, use existing ontologies from:
 - the Biomedical Informatics Research Network (BIRN)
 - the cancer Biomedical Informatics Grid (caBIG)
 - the National Center for Biomedical Ontologies (NCBO)
 - * Develop new concepts that are of special importance in CV research
- Deposit new CV ontologies at the NCBO
- Work to harmonize terms with the NCI Thesaurus/Meta-Thesaurus as needed

CVRG-NCBO Driving Biological Project (DBP)

- Use NCBO tools ([Protégé](#), [BioPortal 2.0](#)) to develop, manage & access a comprehensive ECG ontology
 - * Original plan:
 - Use BioPortal to find pre-existing concepts (and their ontology)
 - Use Protégé to develop the ECG ontology
 - Load other ontologies into Protégé, to use their concepts without having to transcribe them
 - Use BioPortal to store and manage the ontology
 - * New plan:
 - **Develop a tool to utilize BioPortal's Representational State Transfer (REST) services, to obtain pre-existing ECG concepts & definitions and export them in OWL**
 - Use Protégé to extend the ontology with novel ECG concepts
 - Use BioPortal to store and manage the ontology

Benefits of the tool

- Concept Provenance
 - * Cites source of the concept & definition, providing a timestamp for the information capture
- Obtains a subset of pre-existing ontologies quickly
 - * Original plan required importing entire ontologies to use just a few concepts
 - Foundational Model of Anatomy (FMA)
 - Anatomical structure concepts
 - National Cancer Institute (NCI) Thesaurus
 - EKG wave concepts
- Enhancement of concept mapping to pre-existing ontologies
 - * Concepts and definitions match exactly, making mapping easy & automatable

Design

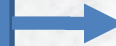
Search
Ontology
Concept(s)



Parse
Concept(s)
Details

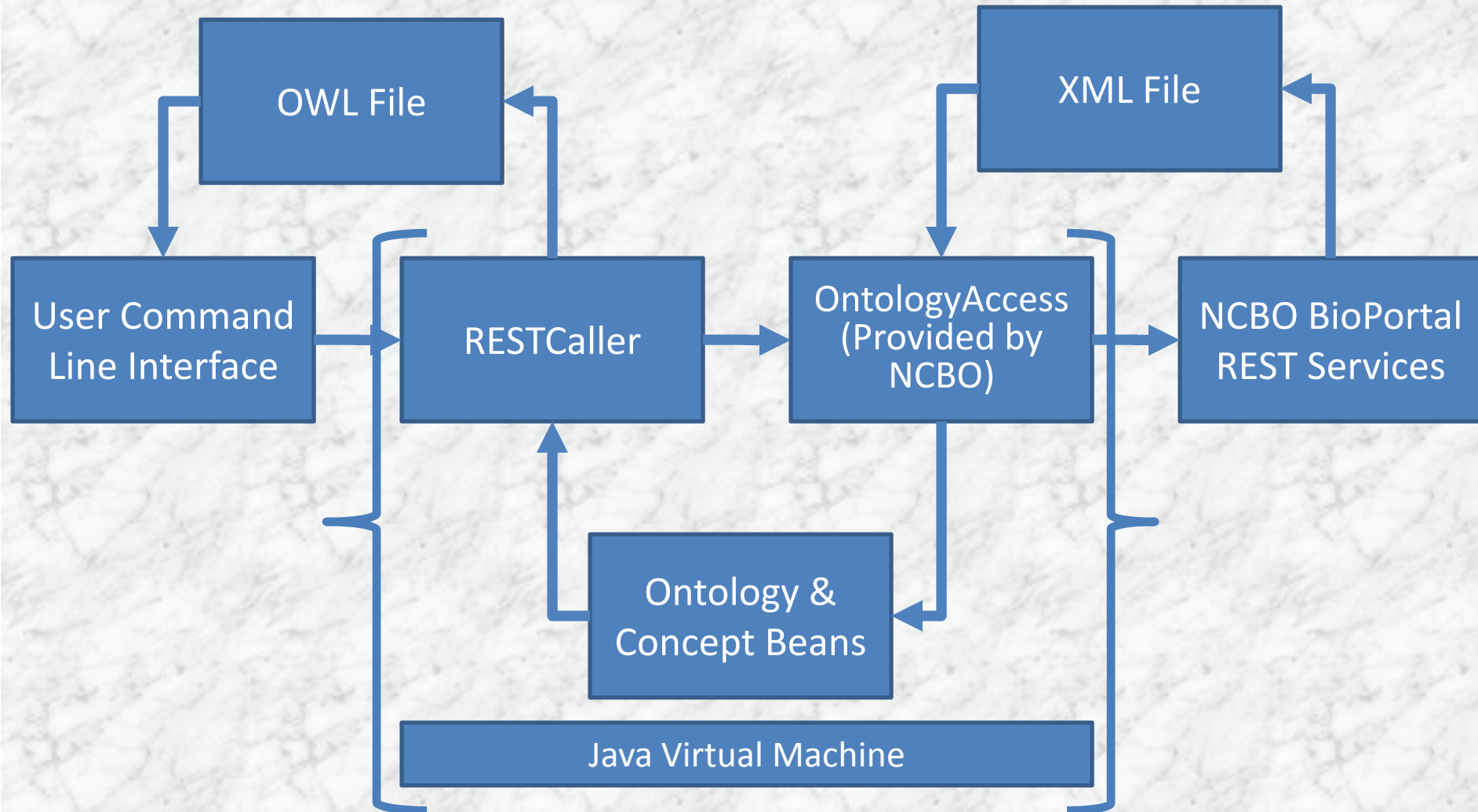


Reformat
Concept(s) in
OWL

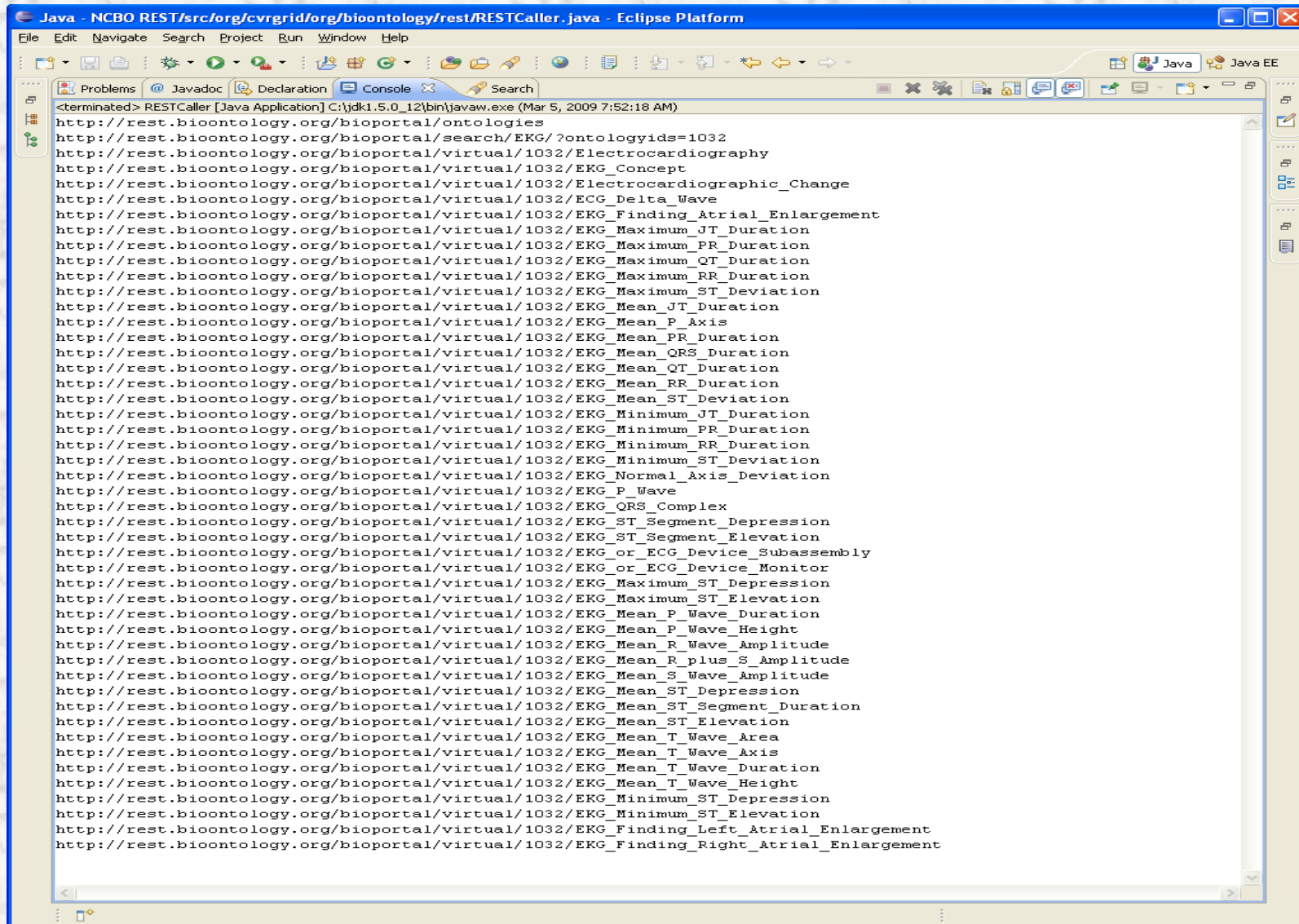


Append OWL to
local file

Latest Implementation



Use Case – search “EKG” in NCI Thesaurus



```
Java - NCBO REST/src/org/cvrgrid/org/bioontology/rest/REStCaller.java - Eclipse Platform
File Edit Navigate Search Project Run Window Help

<terminated> REStCaller [Java Application] C:\jdk1.5.0_12\bin\javaw.exe (Mar 5, 2009 7:52:18 AM)
http://rest.bioontology.org/bioportal/ontologies
http://rest.bioontology.org/bioportal/search/EKG/?ontologyids=1032
http://rest.bioontology.org/bioportal/virtual/1032/Electrocardiography
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Concept
http://rest.bioontology.org/bioportal/virtual/1032/Electrocardiographic_Change
http://rest.bioontology.org/bioportal/virtual/1032/ECG_Delta_Wave
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Finding_Atrial_Enlargement
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_JT_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_PR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_QT_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_RR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_ST_Deviation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_JT_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_P_Axis
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_PR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_QRS_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_QT_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_RR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_ST_Deviation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_JT_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_PR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_RR_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_ST_Deviation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Normal_Axis_Deviation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_P_Wave
http://rest.bioontology.org/bioportal/virtual/1032/EKG_QRS_Complex
http://rest.bioontology.org/bioportal/virtual/1032/EKG_ST_Segment_Depression
http://rest.bioontology.org/bioportal/virtual/1032/EKG_ST_Segment_Elevation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_or_ECG_Device_Subassembly
http://rest.bioontology.org/bioportal/virtual/1032/EKG_or_ECG_Device_Monitor
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_ST_Depression
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Maximum_ST_Elevation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_P_Wave_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_P_Wave_Height
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_R_Wave_Amplitude
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_R_plus_S_Amplitude
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_S_Wave_Amplitude
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_ST_Depression
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_ST_Segment_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_ST_Elevation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_T_Wave_Area
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_T_Wave_Axis
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_T_Wave_Duration
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Mean_T_Wave_Height
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_ST_Depression
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Minimum_ST_Elevation
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Finding_Left_Atrial_Enlargement
http://rest.bioontology.org/bioportal/virtual/1032/EKG_Finding_Right_Atrial_Enlargement
```


Use Case Results

The screenshot displays the EKG Protégé 3.3.1 software interface. The main window is titled "EKG Protégé 3.3.1 (file:VC:VEKG.pprj, OWL / RDF Files)". The interface includes a menu bar (File, Edit, Project, OWL, Code, Tools, Window, Help) and a toolbar with various icons. The left pane shows the "SUBCLASS EXPLORER" for the project "EKG", listing a hierarchy of classes under "owl:Thing". The right pane is the "CLASS EDITOR" for the class "EKG_Delta_Wave". It features a table with properties and their values, and a section for "Asserted Conditions".

CLASS EDITOR: EKG_Delta_Wave

Property	Value	Lang
rdfs:comment		
dc:creator	Stephen J. Granite	
dc:date	2009-03-05 07:52:30	
dc:description	An initial slurring (delta wave) of the QRS complex due to the presence of an accessory pathway. This characteristic EKG pattern is typically seen in Wolff-Parkinson-White syndrome.	
dc:source	NCI Thesaurus	

Asserted Conditions

owl:Thing

Disjoints

Logic View Properties View

<http://bioportal.bioontology.org/visualize/40144>

Future Development

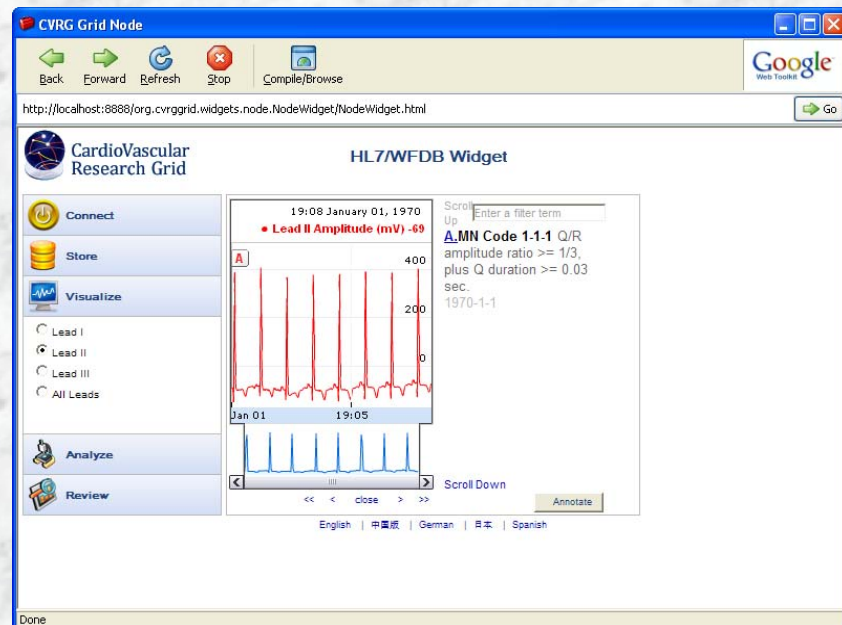
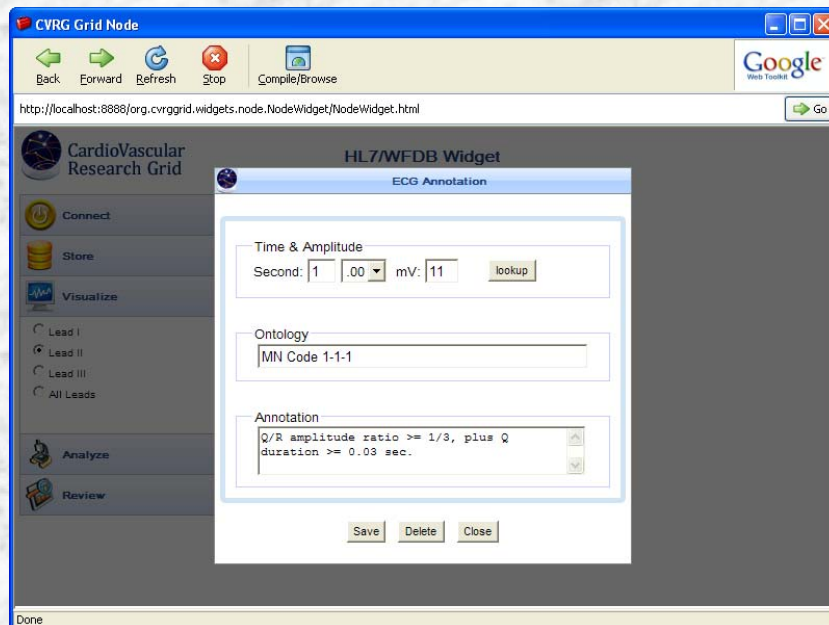
- Development of a GUI interface
 - * Current interface = single ontology command line search tool
 - * GUI interface allows user to search multiple ontologies and save their search parameters
- Utilize the Protégé OWL API
 - * Current interface utilizes OntologyAccess API, but not OWL API
 - * OWL API would assist in preserving the hierarchical structure of concepts returned from the NCBO BioPortal REST services

Using the ECG Ontology: CVRG ECG Web Interface

- Prototype ECG Widget
 - * Leverages Google Web Toolkit (GWT; <http://code.google.com/webtoolkit/>)
 - * Leverages Google Visualization API (<http://code.google.com/apis/visualization/>)
 - * Can exist in a portal, a web page, a dashboard, a flash drive and/or a handheld device (e.g. G3 phone)
 - Expands avenues of access to the tool, “putting it in the hands of the users”
 - Functions on multiple platforms and multiple browsers
 - * Can internationalize the tools developed without requiring additional code

Web Interface Functionality

- Functionality implemented:
 - * Integrates the ECG workflows into one unified workflow
 - Accepts ECG formats workflows processed and stores in one format
 - Allows for in-memory translation to other formats
 - * Extends the capability of scrolling visualization of the ECG
 - Allows for annotation within the waveform, leveraging NCBO REST Services real-time



CVRG NCBO DBP Web Resources

- **CVRG Website** – Information about the CVRG
(<http://www.cvrgrid.org/>)
- **NCBO DBP Tool** – Project information and source code available
via JHU ICM gForge site
(http://gforge.icm.jhu.edu/gf/projects/ncbo_dbp/)

Acknowledgements

- Protégé
 - ✱ The Protégé Development Team (Past, Present & Future)
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 - ✱ The BioPortal Development Team
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- ECG Widget Prototype
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- NCBO Driving Biological Project

Questions and Discussion