ReqWiki: A Semantic System for Collaborative Software Requirements Engineering with Integrated Text Analysis Support

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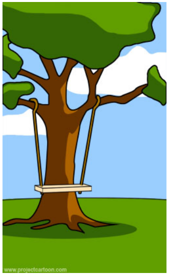
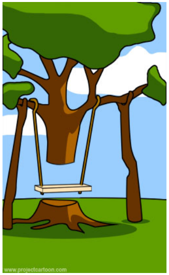
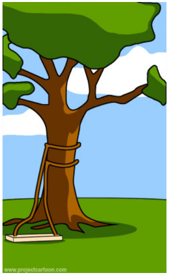
Motivation

- Requirements Engineering (RE) is the process of eliciting, evaluating, and recording the needs of various stakeholders of a software project
- Heavily knowledge-driven and collaborative task
- Critical to building "the right product"







Introduction

Software Requirements Specfcations (SRS)

- Up to 90 of requirements specifications are written in natural language
- Inherent ambiguity in using natural language
- Support Unified Process (UP) methodology
- Use Cases, Test Cases, etc.

SRS Tools

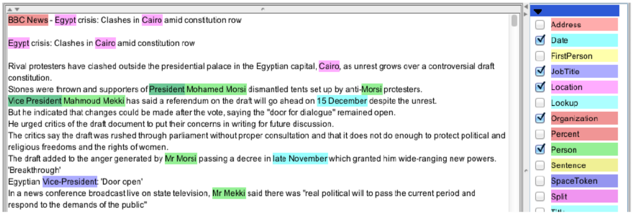
- Enterprise tools vs. general Office tools (used in SMEs)
- Wikis recently emerged as affordable collaborative tools in RE
- Wikis require structure and customization for RE

Intelligent Assistants

- Automated "assistants" that work collaboratively with humans on SRS
- Using Natural Language Processing (NLP) for quality assurance
- Semantic technologies (ontologies) for traceability, etc.

Natural Language Processing (NLP)

- A branch of Artificial Intelligence
  - uses various techniques to process content written in natural language
- Multitude of NLP techniques
  - Named Entity Recognition (e.g., Finding Persons, Organizations, etc.)
  - Quality Assessment
  - Summarization
- Various NLP APIs (e.g., OpenCalais, GATE, . . .)



BBC News - Egypt crisis: Clashes in Cairo amid constitution row

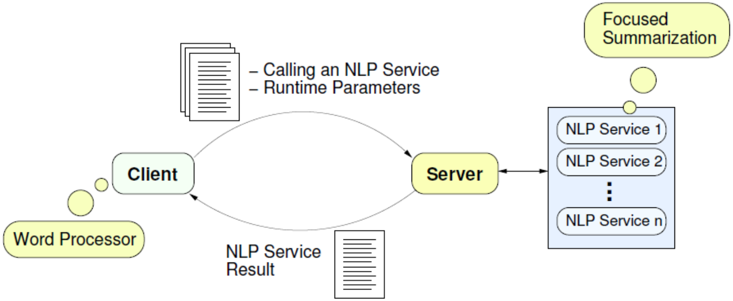
Egypt crisis: Clashes in Cairo amid constitution row

Rival protesters have clashed outside the presidential palace in the Egyptian capital, Cairo, as unrest grows over a controversial draft constitution.
Stones were thrown and supporters of President Mohamed Morsi dismantled tents set up by anti-Morsi protesters.
Vice President Mahmoud Mekki has said a referendum on the draft will go ahead on 15 December despite the unrest.
But he indicated that changes could be made after the vote, saying the "door for dialogue" remained open.
He urged critics of the draft document to put their concerns in writing for future discussion.
The critics say the draft was rushed through parliament without proper consultation and that it does not do enough to protect political and religious freedoms and the rights of women.
The draft added to the anger generated by Mr Morsi passing a decree in late November which granted him wide-ranging new powers.
'Breakthrough'
Egyptian Vice-President: 'Door open'
In a news conference broadcast live on state television, Mr Mekki said there was "real political will to pass the current period and respond to the demands of the public"

- ☐ Address
- ☑ Date
- ☐ FirstPerson
- ☑ JobTitle
- ☑ Location
- ☐ Lookup
- ☑ Organization
- ☐ Percent
- ☑ Person
- ☐ Sentence
- ☐ SpaceToken
- ☐ Split

Semantic Assistants

- Service-oriented Architecture (SOA)
- Publishes various NLP pipelines as W3C Standard Web services
- Open source framework (http://www.semanticassistants.com)



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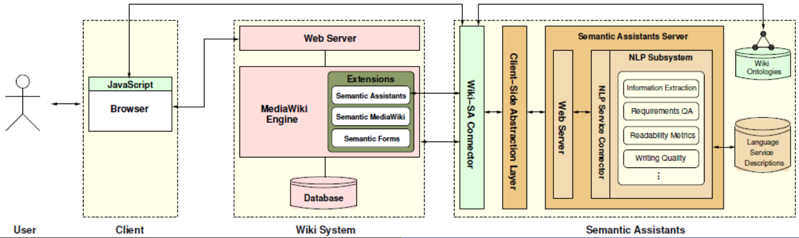
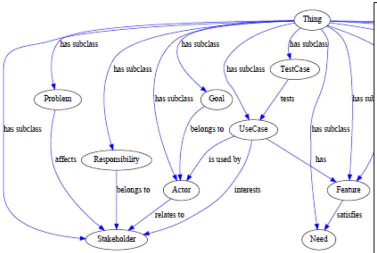
ReqWiki Architecture

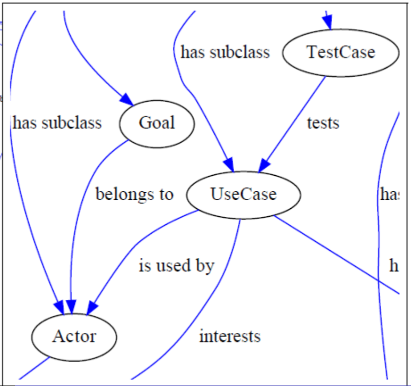
- Collaborative RE platform with integrated text analysis support
- Powered by the MediaWiki engine
- Based on the Semantic Assistants Wiki-NLP Integration
- Provides seamless integration of NLP capabilities within wikis
- Includes ontological formalization of SRS entities and their relationships



Semantic model for SRS

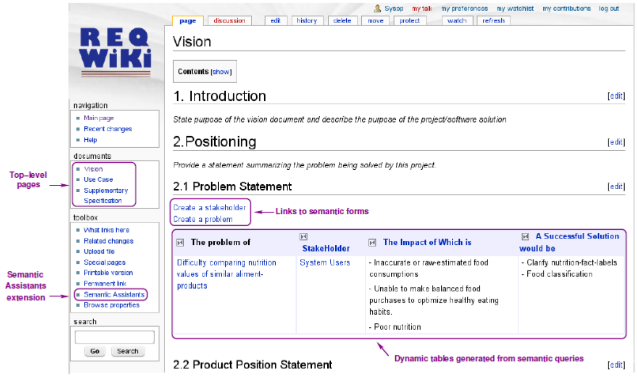
- Formally describe software artifacts and their components
- Used to model, connect and query SRS statements with ontology concepts





User Interface

- Semantic MediaWiki customized for collaborative requirements engineering
- Follows Unified Process (UP) methodology
- Structures SRS artifacts using forms and templates based on ontology



Vision

Contents [show]

1. Introduction [edit]

State purpose of the vision document and describe the purpose of the project/software solution

2. Positioning [edit]

Provide a statement summarizing the problem being solved by this project.

2.1 Problem Statement [edit]

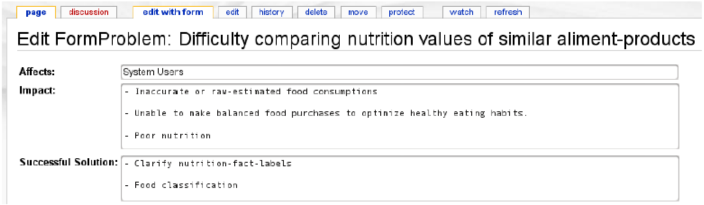
Create a stakeholder
Create a problem

The problem of	StakeHolder	The Impact of Which is	A Successful Solution would be
Difficulty comparing nutrition values of similar aliment-products	System Users	- Inaccurate or raw-estimated food consumptions - Unable to make balanced food purchases to optimize healthy eating habits. - Poor nutrition	- Clarify nutrition-fact-labels - Food classification

2.2 Product Position Statement [edit]

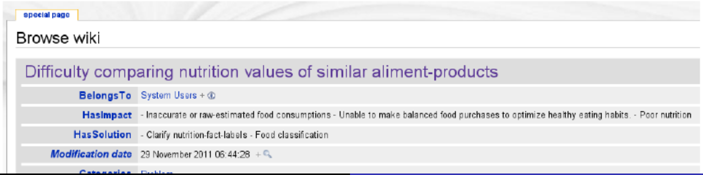
Semantic forms

- Semantic Forms as data entry point
- Structures content at fner granularities
- Automatically generates RDF markup for linking and querying



Edit FormProblem: Difficulty comparing nutrition values of similar aliment-products

Affects:	System Users
Impact:	- Inaccurate or raw-estimated food consumptions - Unable to make balanced food purchases to optimize healthy eating habits. - Poor nutrition
Successful Solution:	- Clarify nutrition-fact-labels - Food classification



Browse wiki

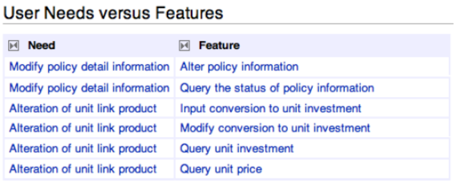
Difficulty comparing nutrition values of similar aliment-products

BelongsTo	System Users +
HasImpact	- Inaccurate or raw-estimated food consumptions - Unable to make balanced food purchases to optimize healthy eating habits. - Poor nutrition
HasSolution	- Clarify nutrition-fact-labels - Food classification
Modification date	29 November 2011 06:44:28 +

Automatic Traceability

- Traceability is concerned with interrelating various software artifacts
- Manually cross-referencing documents is time-consuming and error-prones
- Leverage the semantic metadata in ReqWiki
- Traceability Links
  1. Revision links
  2. Semantic links
  3. Query-based links

```
{{#ask: [[Category:Features]]
| ?BelongsTo=Need
| ? = Feature
| format= table
}}
```

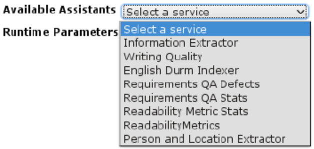


User Needs versus Features

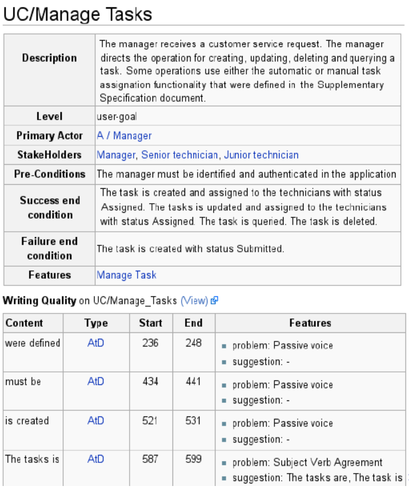
Need	Feature
Modify policy detail information	Alter policy information
Modify policy detail information	Query the status of policy information
Alteration of unit link product	Input conversion to unit investment
Alteration of unit link product	Modify conversion to unit investment
Alteration of unit link product	Query unit investment
Alteration of unit link product	Query unit price

ReqWiki NLP services

- Various NLP services



- SRS defects addressable
  - Spelling and Grammar
  - Incompleteness
  - Ambiguity
  - Poor Structuring
  - Passive voice
  - etc
- Automatically index the SRS
  - back-of-the-book style
  - complement the glossary
  - helping domain analysis



UC/Manage Tasks

Description	The manager receives a customer service request. The manager directs the operation for creating, updating, deleting and querying a task. Some operations use either the automatic or manual task assignation functionality that were defined in the Supplementary Specification document.
Level	user-goal
Primary Actor	A / Manager
StakeHolders	Manager, Senior technician, Junior technician
Pre-Conditions	The manager must be identified and authenticated in the application
Success end condition	The task is created and assigned to the technicians with status Assigned. The tasks is updated and assigned to the technicians with status Assigned. The task is queried. The task is deleted.
Failure end condition	The task is created with status Submitted.
Features	Manage Task

Writing Quality on UC/Manage_Tasks (View)

Content	Type	Start	End	Features
were defined	AtD	236	248	▪ problem: Passive voice ▪ suggestion: -
must be	AtD	434	441	▪ problem: Passive voice ▪ suggestion: -
is created	AtD	521	531	▪ problem: Passive voice ▪ suggestion: -
The tasks is	AtD	587	599	▪ problem: Subject Verb Agreement ▪ suggestion: The tasks are, The task is

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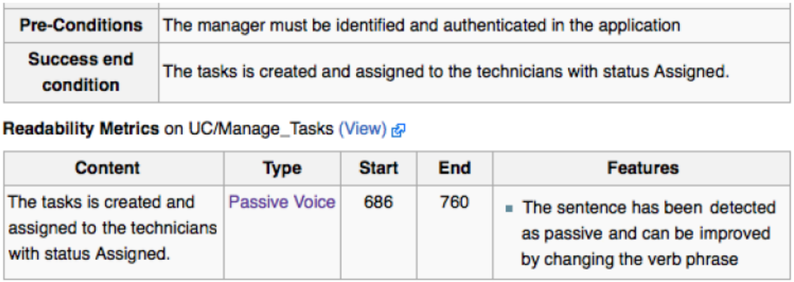
User Study I - Effectiveness

- Can text mining assistants help to improve requirements specifications?
- User study with 2 software engineering classes
  - Goal: Identifying defects in manual vs. NLP-assisted requirements specifications
  - NLP Services:Spell checking, Readability Analysis, Passive Voice Detection,...
  - Measure: Average number of defects found in the two assignment revisions
  - Method: Comparison of manual vs. NLP-assisted quality assurance



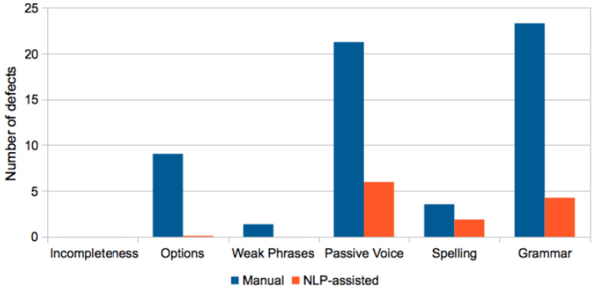
Pre-Conditions	The manager must be identified and authenticated in the application
Success end condition	The tasks is created and assigned to the technicians with status Assigned.

Readability Metrics on UC/Manage_Tasks (View)

Content	Type	Start	End	Features
The tasks is created and assigned to the technicians with status Assigned.	Passive Voice	686	760	▪ The sentence has been detected as passive and can be improved by changing the verb phrase

User Study I - Effectiveness

User study Results

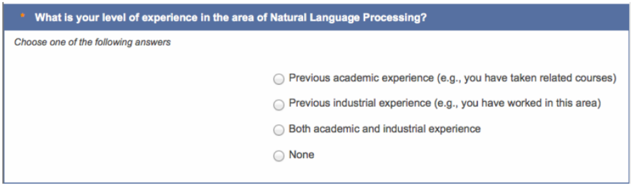


Conclusion

ReqWiki NLP capabilities were indeed effective to significantly reduce SRS defects.

User Study 2 - Usability

- User Study II - Usability How much NLP background do users need in order to use semantic capabilities?
- Same scenario as User Study I
- Anonymized questionnaire asking participants about
  1. Their proficiency level in NLP
  2. ReqWiki ease-of-use



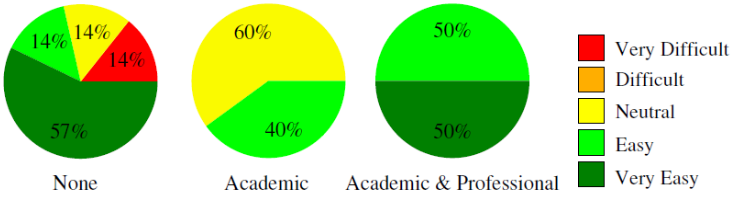
* What is your level of experience in the area of Natural Language Processing?

Choose one of the following answers

- ○ Previous academic experience (e.g., you have taken related courses)
- ○ Previous industrial experience (e.g., you have worked in this area)
- ○ Both academic and industrial experience
- ○ None

User Study 1 - Effectiveness

User study Results



Conclusion

Concrete NLP background is not required to make use of sophisticated semantic support provided in ReqWiki.

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Summary and Outlook

- ReqWiki is a semantic, collaborative platform for RE
- Combination of modern semantic techniques can improve RE
- Help in automate the Software requirements verification
- Uses NLP techniques to find the ambiguous, incomplete, conflicting requirements
- Saves a lot of time