Patient Empowerment by Increasing Information Accessibility In a Telecare System

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Problem

- Medical language is very often hard to understand for lay people

- The communication between doctors and patients can suffer

- Especially when dealing with remote communication that can appear in tele-care systems
Study no.1
(study of accessibility of web page with medical information)

“… On existing consumer health Web pages. We found that only 4% of pages were classified at a lay person level, while the remaining pages were at the level of medical professionals. This indicates that consumer health Web pages are not using appropriate language for their target audience” *

- So 86% of pages were above lay person level!

* Trudi Miller; Gondy Leroy; Samir Chatterjee; Jie Fan; Brian Thoms, A Classifier to Evaluate Language Specificity of Medical Documents, in HICSS 2007. 40th Annual Hawaii International Conference on System Sciences, 2007
Problem

Study no.2
(study of accessibility of information for people with limited English proficiency in USA)

"For twenty-three million Americans who speak English less than "very well," language barriers lead to lower quality of and worse access to health care. ... millions of patients with limited English proficiency forced to accept a lower quality of care than English speakers receive." *

- Therefore several states have laws facilitating medial language access!

The classic solution

- **Language Interpretation** done by **Human Interpreters**.

- The presence of the interpreter makes it possible for the patient and provider to achieve the goals of their encounter as if they were communicating directly with each other.

- One key element of **patient empowerment** is enhancing **accessibility** to information of interest.

- There are several international institutions like **IMIA (International Medical Interpreters Association)** that are providing standards and frameworks for medical interpreters.
Our Case

- **TELEASIS** = tele-care/tele-assistance system for elder people

- TELEASIS – National Romanian Project/Grant

- among surveillance and alarm functions TELEASIS system is offering:

  - access for patients to their health data, reports and additional medical information.
    - all this data is stored in an information and content database.

  - enrolled medical can add documents to this database, and can set the access rights for patients.
Our Case

TELEASIS architecture:

Home Tele-assistance part

- Medical devices
- Environment Sensors
- RFID Sensors

MITAS
Integrating module for home Tele-assistance

INTERNET

Public electronic services

Tele-assistance Dispatcher

PC, TV, PDA

Medical Assistance

Social Assistance
Patients accessing medical data

- Sequences for accessing interpreted medical data:
Patients accessing medical data

- Sequences for accessing interpreted medical data:

We’ll focus on the Language Interpretation Engine.
Example

- Example of how the interpretation is done by the Language Interpretation Engine:

**Original Text:**

“Aspiration of the marrow has been primarily utilized for cytologic assessment, with analysis directed toward morphology and obtainment of a differential cell count”

**Interpreted Text:**

“Aspiration of the marrow has been primarily utilized for cytologic assessment (cytologic assessment = cells evaluation) with analysis directed toward morphology and obtainment of a differential cell count”
How it works

- It is a web service written in Java, having two main parts:

*Text parser*
- working on raw or tagged text (like HTML)
- iterating through all the words and checking whether the word is contained by the dictionary or not.
- able to tag words and offer output as XML, HTML

*Terminology Dictionary*
- a dictionary containing medical terminology
- uses a specialized & original data structure allowing *fuzzy string matching* called: Fuzzy Hash Map
How it works
Fuzzy Medical Dictionary

- Many times the terms are not in the canonical form

- We use a Fuzzy Hash Map for the medical specific terminology dictionary.

- **Example:** we consider we are parsing the following phrase:
  “... in *diabetic* diet recommendations ...“
  Each word is checked against the dictionary.  
  Fuzzy Hash Map is able to match *diabetic* with *diabet* by
  - *substring* prehashing
  - calculating the **Levensthein Distance** between the two words
Fuzzy Hash Map

- It’s an extension to a regular java HashMap, allowing fuzzy search
- It was developed for this project but can be used in other areas
- A detailed presentation of this data structure can be found in a dedicated article *
- The data structure project is available as open source at: http://sourceforge.net/projects/fuzzyhashmap/

* V. Topac; Efficient Fuzzy Search Enabled Hash Map; 4th International Workshop on Soft Computing Applications (SOFA); July 2010; pages 39 - 44;
Interpretation

- We tried to follow some IMIA standards for human medical interpretations

- Why have we not done a complete translation to lay language (why not phrase translation rather then terminology translation)?

  a. **Safety reasons** – by performing terminology translation a translation error would be easily identified by users

  b. **Message confidence** - an interesting research* concluded that a translation to lay language may decrease the confidence level of the message for patients.

  c. **Educational reasons** – by seeing both the medical terms and their meaning users will learn medical terminology by time

Current status

- The project is functional but was only tested inside our laboratory, so not yet used in real world

- Currently the system works for Romanian and English languages

- Some test results:

  - Parse text from *eMedicine* web site
    - text of 2730 words
    - 260 were recognized
    - 7 were incorrect matches
    - 97% accuracy

  - Parse text from *American Family Physicians Journal*
    - text of 568 words
    - 43 words identified as medical terms
    - 9 were incorrect matches
    - 80% accuracy
**Current status**

- Website for language interpretation project, beta version:
Future work

- Increase the accuracy of terminology recognition
- Enrich the dictionaries with more terminology
- Add new languages
- Make the service work as a standalone service/website (we already have a beta version)
- Make real word tests (with elder people and other kinds of patients)
Conclusions

- Studies show that increasing the accessibility to medical data is important

- Patients can better understand their own health status and problems; this is leading to patient empowerment.

- The terminology interpretation implemented in this project has a satisfactory accuracy, being a helpful service inside TELEASIS tele-care project

- The fuzzy data structure built for this project has good performances and can be used in other areas (already used in bioinformatics*)

* John Healy and Desmond Chambers; Fast and Accurate Genome Anchoring Using Fuzzy Hash Maps
5th International Conference on Practical Applications of Computational Biology & Bioinformatics (PACBB 2011)
Thank you!

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