Visualization of patent claims structure to improve their readability

Shichao Dong
u5135470@anu.edu.au
Supervisor

Dr. Gabriela FERRARO
NICTA and The Australian National University, Canberra, ACT, Australia

NICTA is funded by the Australian Government through the Department of Communications and the Australian Research Council through the ICT Centre of Excellence Program. NICTA is also funded and supported by the Australian Capital Territory, the New South Wales, Queensland and Victorian Governments, the Australian National University, the University of New South Wales, the University of Melbourne, the University of Queensland, the University of Sydney, Griffith University, Queensland University of Technology, Monash University and other university partners.
Introduction

Objectives:

✔ Revise the state-of-the-art literatures about text readability;
✔ Built a software application that visualize the patent claims hierarchical structure;
✔ Design a user study evaluation to assess whether the proposed software improves the reading experience.
Motivation

1. Language learning
2. Selection for different group education

Education

Health

Law

1. People with cognitive reading disability.
2. Medical records

1. Contracts
2. Licences
3. Patent Documents
Patent claims are difficult to read and understand

- Patent claims contains knowledge in certain field
- Patent claims contains complex linguistic structure
- Patent claims are written in long sentence

There is a need for method and technique to improve the patent claim readability

The patent claims are organized in the hierarchical structure
Readability

Karmakar and Zhu (2010) define that:

- A document readability could be regarded as an indicator of this document's understandability to particular groups of readers.

- High readability include: improved readership, good comprehension, clear memorization, fast reading speed, and long reading persistence.

Patent claims

**Patent** are legal documents that have a predefined document structure consisting of several sections, such as title, abstract, background of the invention, description of the drawings and claims.

**The claims** are the most important section as they define the scope of legal protection of the invention. In most modern patent laws, patent applications must have at least one claim.
Patent claims hierarchical structure

- **Independent claims (IC)**: independent claims stand on their own. These kind of claims do not refer back to the previous claims (Pressman, 2012). Basically, they define the scope in a broad and general way. The first claim of a patent is always an independent claim.

- **Dependent claims (DC)**: dependent claims make references to the claim they dependent on (Pressman, 2012). They refer back to one or more than one claims from the previous claims. Compared with the IC, dependent claims define the right protection in a narrow scope. The references to other claims are made explicit by textual refer read in isolation, they should be read after understanding the claims they dependent on.
## Patent claims hierarchical structure

<table>
<thead>
<tr>
<th>Independent claims (IC)</th>
<th>Dependent claims (DC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>stands on their own</td>
<td>makes references</td>
</tr>
<tr>
<td>do not refer back</td>
<td>refer back to one or more than one claims</td>
</tr>
<tr>
<td>define the scope in a broad and general way</td>
<td>define the right protection in a narrow scope</td>
</tr>
<tr>
<td>read alone</td>
<td>read after understanding the claims they dependent on</td>
</tr>
<tr>
<td>first claim</td>
<td></td>
</tr>
</tbody>
</table>
Example-Independent claims (IC)

A boring tool comprising a body, a plurality of cutting blades supported by the body so as to be movable along paths equally incline at an acute angle to an axis of rotation of the body, outer ends of the blades having cutting edges and projecting beyond the body, characterized by a rotatable blade advancing member having a screwed shank within a threaded bore on the axis of rotation and a head abutting inner ends of the blades for advancing and retracting the blades on their paths consequent upon rotation of the shank within the bore, and means operable from the exterior of the body for causing rotation of the blade advancing member.
Example-Dependent claims (DC)

A boring tool according to claim 1 characterized in that the means for causing rotation of the blade advancing member comprises a worm rotatable by a detachable handle or key and a meshing worm wheel secured to a shaft extending from the shank of the blade advancing member and co-axial with.

A boring tool according to claim 1 or 2 characterized in that the tool advancing member has a head with a conical surface abutting the inner ends of the cutting blades.

A boring tool according to any of claims 1-4 characterized in that the cutter blades are guided by holes in the body which lie in planes radial to the axis of rotation.
Data Example
## Data Example

<table>
<thead>
<tr>
<th>Keys</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Id</td>
<td>CLM-00002</td>
</tr>
<tr>
<td>Body, transPhrase, claim_preamble</td>
<td>Content of the claim</td>
</tr>
<tr>
<td>Claim type</td>
<td>dependent</td>
</tr>
<tr>
<td>claimBackReference</td>
<td>Of claim 1</td>
</tr>
<tr>
<td>claimSize</td>
<td>20</td>
</tr>
<tr>
<td>Claim Text</td>
<td>2. The building structure of wherein an upper surface of the elongate protrusion is flat.</td>
</tr>
</tbody>
</table>
Literature Review

- The Text readability and improvement
- The patent claim readability and improvement
- The patent claim readability improvement through visualization
Improving text readability through linguistic techniques

- Offering support for difficult words (Brooke et al. (2012))

- Text simplification (CENTAL (2014), De Belder and Moens (2010), Woodsend and Lapata (2011))

- Building detections for abbreviation, terminology, correcting spelling and splitting compound (Grigonytea et al. (2014), Kvist et al. (2011))
Improving text readability through visualization

- Character presentation (e.g. font size) (Legge and Bigelow (2011), O’Brien et al. (2005))
- Sentence presentation (e.g. sentence length, space) (Schneps et al. (2013), Zorzi et al. (2012))
- Document presentation (e.g. web browser plug-in) (de Santana et al. (2013), Gregor et al. (2003))
- Apply specific rules (e.g. web for age over 40) (Nielsen (2011), Santana et al. (2012))
- Visualizing metrics (e.g. paragraph understandability) (Karmakar and Zhu (2010))
Improving the patent claim readability

- Visualizing the structure (independent & dependent) (Sheremetyeva (2003))
- Claim summarization and paraphrase (Shinmori et al. (2003), Bouayad-Agha et al. (2009))
- Identify linguistic parts in the claims (e.g. find the boundary in texts using ML method) (Sang and Déjean (2001))
- Using gazetteers or other index (Smith and Osborne (2006))
- Improve presentation of claims without changing the text (Ferraro et al. (2014))
Implementation – The input example

**Patent Claims**


1. A boring tool comprising a body, a plurality of cutting blades supported by the body so as to be movable along paths equally inclined at an acute angle to an axis of rotation of the body, outer ends of the blades having cutting edges and projecting beyond the body, characterised by a rotatable blade advancing member having a screwed shank within a threaded bore on the axis of rotation and a head abutting inner ends of the blades for advancing and retracting the blades on their paths consequent upon rotation of the shank within the bore, and means operable from the exterior of the body for causing rotation of the blade advancing member.

2. A boring tool according to claim 1 characterised in that the means for causing rotation of the blade advancing member comprises a worm rotatable by a detachable handle or key and a meshingworm wheel secured to a shaft extending from the shank of the blade advancing member and co-axial therewith.

3. A boring tool according to claim 1 or 2 characterised in that the tool advancing member has a head with a conical surface abutting the inner ends of the cutting blades.

4. A boring tool according to claim 1 characterised in that the head lies within a cylindrical cavity extending inwardly from one end of the body member, the open end of the cavity being closed by a plug which backs a frusto-conical pressure pad supporting the cutter blades.

5. A boring tool according to any of claims 1-4 characterised in that the cutter blades are guided by holes in the body which lie in planes radial to the axis of rotation.

6. A boring tool according to any of claims 1-5 characterised in that a serrated drive spigot co-axial with the axis of rotation of the tool is mounted on one end of the body remote from the cutting blades and for insertion within a corresponding socket in a drive adaptor, the tool being detachably securable to the adaptor by a ring nut engageable with a screw threaded portion of the adaptor.

7. A boring tool according to claim 6 characterised in that the adaptor has a threaded hole to engage the screwed end of a power drill drive shaft.
Three Experiments

- Test 1: Raw texts
- Test 2: EPO approach
- Test 3: Our approach
1. A boring tool comprising a body, a plurality of cutting blades supported by the body so as to be movable along paths equally incline at an acute angle to an axis of rotation of the body, outer ends of the blades having cutting edges and projecting beyond the body, characterised by a rotatable blade advancing member having a screwed shank within a threaded bore on the axis of rotation and a head abutting inner ends of the blades for advancing and retracting the blades on their paths consequent upon rotation of the shank within the bore, and means operable from the exterior of the body for causing rotation of the blade advancing member.

2. A boring tool according to claim 1 characterised in that the means for causing rotation of the blade advancing member comprises a worm rotatable by a detachable handle or key and a meshing worm wheel secured to a shaft extending from the shank of the blade advancing member and co-axial therewith.

3. A boring tool according to claim 1 or 2 characterised in that the tool advancing member has a head with a conical surface abutting the inner ends of the cutting blades.

4. A boring tool according to claim 1 characterised in that the head lies within a cylindrical cavity extending inwardly from one end of the body member, the open end of the cavity being closed by a plug which backs a frusto-conical pressure pad supporting the cutter blades.

5. A boring tool according to any of claims 1-4 characterised in that the cutter blades are guided by holes in the body which lie in planes radial to the axis of rotation.

6. A boring tool according to any of claims 1-5 characterised in that a serrated drive spigot co-axial with the axis of rotation of the tool is mounted on one end of the body remote from the cutting blades and for insertion within a corresponding socket in a drive adaptor, the tool being detachably securable to the adaptor by a ring nut engageable with a screw threaded portion of the adaptor.

7. A boring tool according to claim 6 characterised in that the adaptor has a threaded hole to engage the screwed end of a power drill drive shaft.
According to official introduction (official webpage), the European Patent Office (EPO) is the executive arm of the European Patent Organization which offers inventors seeking patent protection in up to 40 European countries. The EPO provides a service that we can search and explore the claims with plot views.
1. A boring tool comprising a body, a plurality of cutting blades supported by the body so as to be movable along paths equally incline at an acute angle to an axis of rotation of the body, outer ends of the blades having cutting edges and projecting beyond the body, characterised by a rotatable blade advancing member having a screwed shank within a threaded bore on the axis of rotation and a head abutting inner ends of the blades for advancing and retracting the blades on their paths consequent upon rotation of the shank within the bore, and means operable from the exterior of the body for causing rotation of the blade advancing member.

2. A boring tool according to claim 1 characterised in that the means for causing rotation of the blade advancing member comprises a worm rotatable by a detachable handle or key and a meshing worm wheel secured to a shaft extending from the shank of the blade advancing member and co-axial therewith.

3. A boring tool according to claim 1 or 2 characterised in that the tool advancing member has a head with a conical surface abutting the inner ends of the cutting blades.

4. A boring tool according to claim 1 characterised in that the head lies within a cylindrical cavity extending inwardly from one end of the body member, the open end of the cavity being closed by a plug which backs a frusto-conical pressure pad supporting the cutter blades.

5. A boring tool according to any of claims 1-4 characterised in that the cutter blades are guided by holes in the body which lie in planes radial to the axis of rotation.

6. A boring tool according to any of claims 1-5 characterised in that a serrated drive spigot co-axial with the axis of rotation of the tool is mounted on one end of the body remote from the cutting blades and for insertion within a corresponding socket in a drive adaptor, the tool being detachably securable to the adaptor by a ring nut engagesble with a screw threaded portion of the adaptor.

7. A boring tool according to claim 6 characterised in that the adaptor has a threaded hole to engage the screwed end of a power drill drive shaft.
Our Approach

- Flat structure
- Concentration to content
- Clear Connection
1. A boring tool comprising a body, a plurality of cutting blades supported by the body so as to be movable along paths equally incline at an acute angle to an axis of rotation of the body, outer ends of the blades having cutting edges and projecting beyond the body, characterised by a rotatable blade advancing member having a screwed shank within a threaded bore on the axis of rotation and a head abutting inner ends of the blades for advancing and retracting the blades on their paths consequent upon rotation of the shank within the bore, and means operable from the exterior of the body for causing rotation of the blade advancing member.

2. A boring tool according to claim 1 characterised in that the means for causing rotation of the blade advancing member comprises a worm rotatable by a detachable handle or key and a meshing worm wheel secured to a shaft extending from the shank of the blade advancing member and co-axial therewith.

3. A boring tool according to claim 1 or 2 characterised in that the tool advancing member has a head with a conical surface abutting the inner ends of the cutting blades.

4. A boring tool according to claim 1 characterised in that the head lies within a cylindrical cavity extending inwardly from one end of the body member, the open end of the cavity being closed by a plug which backs a frusto-conical pressure pad supporting the cutter blades.

5. A boring tool according to any of claims 1-4 characterised in that the cutter blades are guided by holes in the body which lie in planes radial to the axis of rotation.

6. A boring tool according to any of claims 1-5 characterised in that a serrated drive spigot co-axial with the axis of rotation of the tool is mounted on one end of the body remote from the cutting blades and for insertion within a corresponding socket in a drive adaptor, the tool being detachably securable to the adaptor by a ring nut engagesble with a screw threaded portion of the adaptor.

7. A boring tool according to claim 6 characterised in that the adaptor has a threaded hole to engage the screwed end of a power drill drive shaft.
Comparison

- Flat view and Tree view
- “and” & “or” relationship
- Link to the previous claims
Flat view and Tree view

Part of the tree view for claims: Complex example
Flat view and Tree view
Flat view and Tree view
Flat view and Tree view
“and” & “or” relationship

3. A boring tool according to claim 1 or 2 characterised in that the tool advancing member has a head with a conical surface abutting the inner ends of the cutting blades.
“and” & “or” relationship

5. A boring tool according to any of claims 1-4 characterised in that the cutter blades are guided by holes in the body which lie in planes radial to the axis of rotation.
1. A boring tool comprising a body, a plurality of cutting blades supported by the body so as to be movable along paths equally incline at an acute angle to an axis of rotation of the body, outer ends of the blades having cutting edges and projecting beyond the body, characterised by a rotatable blade advancing member having a screwed shank within a threaded bore on the axis of rotation and a head abutting inner ends of the blades for advancing and retracting the blades on their paths consequent upon rotation of the shank within the bore, and means operable from the exterior of the body for causing rotation of the blade advancing member.

2. A boring tool according to claim 1 characterised in that the means for causing rotation of the blade advancing member comprises a worm rotatable by a detachable handle or key and a meshing worm wheel secured to a shaft extending from the shank of the blade advancing member and co-axial therewith.

3. A boring tool according to claim 1 or 2 characterised in that the tool advancing member has a head with a conical surface abutting the inner ends of the cutting blades.

4. A boring tool according to claim 1 characterised in that the head lies within a cylindrical cavity extending inwardly from one end of the body member, the open end of the cavity being closed by a plug which backs a frictional pressure pad supporting the cutting blades.

5. A boring tool according to any of claims 1-4 characterised in that the cutting blades are guided by holes in the body which lie in planes radial to the axis of rotation.

6. A boring tool according to any of claims 1-5 characterised in that a serrated drive spigot co-axial with the axis of rotation of the tool is mounted on one end of the body remote from the cutting blades and for insertion within a corresponding socket in a drive adaptor, the tool being detachably securable to the adaptor by a ring nut engageable with a screw threaded portion of the adaptor.

7. A boring tool according to claim 6 characterised in that the adaptor has a threaded hole to engage the screwed end of a power drill drive shaft.
6. A boring tool according to any of claims 1-5 characterised in that a serrated drive spigot co-axial with the axis of rotation of the tool is mounted on one end of the body remote from the cutting blades and for insertion within a corresponding socket in a drive adaptor, the tool being detachably securable to the adaptor by a ring nut engagesble with a screw threaded portion of the adaptor.

7. A boring tool according to claim 6 characterised in that the adaptor has a threaded hole to engage the screwed end of a power drill drive shaft.
User study

- Type: survey or questionnaire
- Participant: occupation, age, education
- Question options: strongly agree, somewhat agree, neutral, somewhat disagree and strongly disagree
User study

- **Technology acceptance model (TAM)** (Davis, 1989) attempts to understand why people accept or reject information technologies. In this model, external variables (e.g., user characteristics, political influences, organisational factors, and development process) are expected to influence technology acceptance indirectly by affecting peoples beliefs, attitudes, or intentions (Szajna, 1996).

- **Task technology fit (TTF)** (Goodhue, 1995) views technologies as means for a goal-directed person to perform tasks. It posits that technologies will be used if, and only if, their available functionalities support the users activities.

- **Web site user satisfaction (WSUS)** (Muylle et al., 2004) is based on a two-step study. First, a pilot study was conducted in order to define which items contribute to user satisfaction if using a web interface to interact with technology users. Second, a confirmatory factor analysis was performed for these items and its results demonstrated the adequate validity and reliability of the initial model.
1. In my opinion, it is important to improve the readability of patent documents
2. In my opinion, it is difficult to read patent documents
3. I do not find information I need easily from patent documents in this format
4. In my opinion, I prefer to read raw text
5. In my opinion, I prefer to read raw text with plot demonstration such as tree view about the document structure
6. In my opinion, I prefer to read raw text with notations such as font color, sentence spaces and underline
7. In my opinion, I have never tried texts with settings from Question 4 to 6, but I would like to try if these strategy is available
8. In my opinion, information provided in patent documents as they are is sufficient and further visualization is not needed
9. I feel easy to understand the UI and visualization result
10. I can easily see the structure of the patent claims in this form
11. I do not find information I need easily from patent documents as they are now
12. I can concentrate more in this form compared with raw text
13. I can concentrate more in this form compared with EOP method
14. I cannot understand the demonstration and plots at all
15. In my opinion, this settings and visualization form would contribute to information sufficiency
16. In my opinion, it is difficult to use this kind of improvement option
17. In my opinion, the information and technology structures of this kind of improvement option are clear
18. In my opinion, this kind of improvement option was versatile enough
19. In my opinion, this kind of improvement option dose not perform as I expected, but I still open to the visualization technique and I would like to try more products using this strategy
Conclusion

- Study the state-of-the-art research approaches to improve the readability
- Study the state-of-the-art research approaches to improve the readability by using visualization techniques
- Develop a demo to implement our ideas for improve patent claims readability
- Design user study to evaluate the demo
Future Work

- Implement the user-driven evaluation
- Try other visualization techniques
- Extend this approach to different languages
Reference list


Thank you!

Questions?