Mobile-Friendly Web Browsing

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Motivation

- Not user friendly to browse regular Web pages on mobile devices
- Keeping two versions is costly and may cause inconsistent contents
Mobile-Friendly Web Browsing

- Automatically adapt a regular Web page from a desktop presentation to a mobile presentation
  - Page segmentation: group related information together
  - Adaptive Layout generation: a layout that displays related information in proximity and is suitable for browsing on a mobile device
Related work

- Page segmentation
  - Not identify the semantic role of an information object
  - Web site dependent due to diversity of HTML usages
- Single style adaptive layouts
  - Not support universal usability
Our approach

A Web page

Grammar-based Page Segmentation

Page Abstraction

Grammar Induction

Web Designer

Guide

A graph Grammar

Sample Pages

Grammar Induction

Grammar-based Page Segmentation

Graph Parser

Fine-grained page segmentation

Human-centric Layout Generation

End users

GUI

Layout policy

Layout Generation

Adaptive Layouts
Page Abstraction

- Abstract a Web page as a spatial graph -> Analyze the spatial graph
- A spatial graph
  - Eliminate variations among different Web pages
  - Simplify the original Web page by consolidating information pieces together
  - Remove noises - information objects in the border areas and repetitive images
- A node represents an information object
  - Three types of information nodes: text, link, image
- An edge indicates a close semantic relation
Calculate a semantic relation

- Object A has a close semantic relation with object B if the extended size of A is overlapping with at least two corners of Object B.
**Graph transformation**

*Graph transformation:* A rule-based modification of graphs

- **A production:** A graph transformation rule
  - Pre-condition and Post-condition
  - Replace the pre-condition with the post-condition

![Diagram illustration of graph transformation](image)
Graph grammar

- A set of productions
- A start point
- Terminal graphical objects and non-terminal graphical objects

<table>
<thead>
<tr>
<th>Chomsky Grammar</th>
<th>Graph Grammar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rewriting of strings</td>
<td>Rewriting of graphs</td>
</tr>
<tr>
<td>A textual language</td>
<td>A visual modeling language</td>
</tr>
<tr>
<td>A text parser</td>
<td>A graph parser</td>
</tr>
</tbody>
</table>
The Spatial Graph Grammar

• Introduce spatial information to the abstract syntax
• A more efficient parsing algorithm than that of the reserved graph grammar
• Applications to visual software design and development
The spatial graph grammar (SGG)

- Page segmentation: From one graph (i.e. a spatial graph) to another graph (i.e. a hierarchical structure of semantic grouping) – graph transformation
- Graph grammar provides a natural means to specify page segmentation

(a) An SGG production

Action(AAMGraph g) {
    Product=Merge(Link, Image, Text);
}

(b) A host graph

(c) The graph after graph transformation
Case Study

- A prototype has been developed.
- Extract product information on 21 Web sites
<table>
<thead>
<tr>
<th>Domain Name</th>
<th># of Structured Records</th>
<th>MDR</th>
<th>Our approach</th>
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<tr>
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</tr>
<tr>
<td>Total</td>
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<td>230</td>
<td>235</td>
</tr>
<tr>
<td>Recall/Precision</td>
<td>53.5%</td>
<td>97.9%</td>
<td>98.4%</td>
</tr>
<tr>
<td>F1-Value</td>
<td>69.19%</td>
<td></td>
<td>96.93%</td>
</tr>
</tbody>
</table>
The complexity of a spatial graph
Multi-style Information presentation

- Two Levels
  - Table of Contents
  - Detailed Pages
- Three Adaptive Layouts
  - Anchor Links
  - Single Page
  - Collapsing
- Three Options for Table of Contents
  - Title
  - Image
  - Brief description
# Anchor Links

<table>
<thead>
<tr>
<th>MiniWeb</th>
<th>newegg.com</th>
</tr>
</thead>
<tbody>
<tr>
<td>ViewSonic</td>
<td>ViewSonic VFM1530-11 15&quot; 1024 x 768 Digital Photo Frame</td>
</tr>
<tr>
<td>iHOME</td>
<td>iHOME T110T Electronic Gadgets</td>
</tr>
<tr>
<td>REMO</td>
<td>Remo KD-5400-01 Kids Bongo</td>
</tr>
<tr>
<td>COBY</td>
<td>COBY CX-61 Pocket FM Scan Radio with Backlit Digital Display</td>
</tr>
<tr>
<td>YAMAHA</td>
<td>YAMAHA PA150MM Power Adaptor</td>
</tr>
<tr>
<td>iHOME</td>
<td>iHOME T020S Desktop Alarm Clock with Calendar Display</td>
</tr>
<tr>
<td>Sungale</td>
<td>Sungale AD1020 10.2&quot; Digital Photo Frame</td>
</tr>
<tr>
<td>Energizer</td>
<td>Energizer FNL2BU1CS Industrial Trim Flex LED Flashlight</td>
</tr>
</tbody>
</table>

**ViewSonic VFM1530-11 15" 1024 x 768 Digital Photo Frame**

- **Effective Viewing Area:** 12" x 9" (304mm x 228 mm)
- **Brightness:** 400 cd/m2 (typ)
- **Contrast Ratio:** 500:1 (typ)
- **Aspect Ratio:** 4:3
- **Model #:** VFM1530-11
- **Item #:** N82E16882597034
- **Standard Return Policy**
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<tr>
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<td>🔗 iHome Live Life Loud</td>
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<tr>
<td>Remo KD-5400-01 Kids Bongo</td>
<td>🔗 Remo</td>
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**COLEMAN 200000866 Family size lantern**

**COLEMAN 2000001562 Rechargeable family size lantern**

**ViewSonic VFM1530-11 15" 1024 x 768 Digital Photo Frame**

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*Brightness: 400 cd/m² (typ)*

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**Remo KD-5400-01 Kids Bongo**

**Type:** Drums and Percussion  
**Features:** The bongos are an important part of the Afro-Cuban family of rhythm instruments. Two drums small and large are attached and are pitched high and low.  
**Specifications:** 5"/6" Diameters  
**Height:** 6.5"  
**Model #:** KD-5400-01  
**Item #:** N82E16882926006  
**Standard Return Policy**
MiniWeb: A Mobile Browsing Application

- Running environment: Android 2.2
- Development environment: Android SDK 2.2, the ADT plug-in for eclipse
A Prototype

A Client-Server Architecture

- Server: Run on a Windows machine; Segment a Web page
- Client: Run on an Android device; Display semantically segmented records
Future Research Directions

- Grammar Induction
  - Search for the most common pattern in a spatial graph
  - Only one level structure – not actual grammar induction
  - Evaluation – Efficiency and Accuracy
Future Research Directions

- Mobile Browsing
  - Compare the usability of different mobile browsing styles in different contexts
  - Provide live-preview
  - User study
Conclusion

- Without an adaptation, it is frustrating to browse those pages on mobile devices.
- Automatically adapting Web pages from a desktop Web presentation to a semantically-segmented presentation that is suitable for mobile browsing:
  - Page Segmentation
  - Grammar Induction
  - Layout Generation