GeoSVG and GeoSite
- a Web-based system for manipulative and education page authoring

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GeoSVG Architecture and Components
GeoSVG Architecture and Components (cont.)

- The GeoSVG toolkit:
  a. An SVG-coded *Plane Geometry Engine* for authoring and viewing manipulatives (creating, moving, and animating geometric objects).
  b. GUI for the authoring environment providing authoring logic, a variety of dialogs assisting authoring, publishing, and communications with the server side.

- The GeoSite (http://wme.cs.kent.edu/geosite/main.html): a Web site that makes the GeoSVG toolkit available as well as stores manipulatives and education pages for access, searching, and sharing.
GeoSVG Toolkit for Manipulative Authoring

- Using Firefox for running the GeoSVG toolkit
  - Native SVG support
  - Native MathML support
  - XUL for rapid application development
  - Inter-document communication among SVG, XHTML, MathML, and XUL
  - Cross-platform: Windows, Mac and Linux
Previous version under ASV
Previous version under ASV
Current version under Firefox
Manipulative Authoring Environment
# Complete Web Orientation

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Traditional DGS System</th>
<th>GeoSVG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Software installation</strong></td>
<td>Per Computer installation required</td>
<td>Use through browser, no installation required for authoring or learning</td>
</tr>
<tr>
<td><strong>Manipulative sharing</strong></td>
<td>Difficult because manipulatives are stored on individual computers</td>
<td>Easy because manipulatives are stored and searchable on the Web</td>
</tr>
<tr>
<td><strong>Publishing manipulatives</strong></td>
<td>Authors need to include Java applets in Web pages which are then deployed on servers</td>
<td>Saving a manipulative automatically publishes it on the Web</td>
</tr>
<tr>
<td><strong>Download speed</strong></td>
<td>Applets are binary, large and slow to download</td>
<td>Files are textual, smaller and can be compressed for fast download</td>
</tr>
<tr>
<td><strong>Open Standards</strong></td>
<td>Use proprietary technologies</td>
<td>Use W3C standard Web technologies</td>
</tr>
<tr>
<td><strong>Interoperable with the enclosing page</strong></td>
<td>No</td>
<td>Can be driven by data outside, and output data</td>
</tr>
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</table>

**GeoSVG** refers to the GeoSVG software, which stands for Geo-SVG. Geo-SVG is a software tool designed to create interactive, scalable vector graphics for the web. It is based on the SVG (Scalable Vector Graphics) standard and allows for the creation of dynamic and interactive content that can be embedded in web pages. GeoSVG is designed to be interoperable with the enclosing page, meaning that it can be driven by data outside, and output data can be integrated seamlessly into the web page.

**Traditional DGS System** refers to the traditional Dynamic Geometry System (DGS) software, which is a more general term for software that allows for the creation of dynamic geometry diagrams and interactive mathematical content. Traditional DGS systems are typically based on proprietary technologies and require software installation on individual computers, making them less interoperable with the enclosing page than GeoSVG.

**Manipulative sharing** refers to the ability to share interactive content on the web. GeoSVG makes it easy to share manipulatives because they are stored and searchable on the web, whereas traditional DGS systems make it difficult because manipulatives are stored on individual computers.

**Download speed** refers to the speed at which content is downloaded from the web. GeoSVG uses textual files that are smaller and can be compressed for fast download, whereas traditional DGS systems use binary applets that are large and slow to download.

**Open Standards** refers to the use of standards in software development. GeoSVG uses W3C standard Web technologies, while traditional DGS systems use proprietary technologies, which can limit their compatibility and functionality.
Manipulative Enhancement by the Web

- Flexible authoring support in a manipulative (next slide)
- Input and output interface of a manipulative
- Page composition with answer checking
- Submittable manipulative
- Keywords and search
Flexible authoring support in a manipulative
Dynamic Calculator – the bridge connecting manipulatives and the enclosing page
GeoSite
Education Page Authoring

• A page consists of sections and manipulatives

• Manipulative
  – Output interface: output data used by sections
  – Input interface: driven by sections

• Section: text, quantities, inputs, and buttons
  – Quantities and buttons defined by the dynamic calculator
  – Output interface: some quantities and inputs
  – Input interface: some quantities
Education Page Authoring: Manipulative and Section

1. The measured radius of the circle is 1.25. Please calculate the area of a semi-circle: ______ Check it
Hands-on

• URL: http://wme.cs.kent.edu/geosite/main.html
• Username: type the username you want to use on the left sidebar
  – tester1
  – paul
  – michael
  – adnan
  – saleh
  – cem
  – xiao

• Just for demo: no error checking for wrong username, wrong manipulative URL, strange characters in section composition
Analysis of Section and Manipulative Structures

- *Input Interface*: fields that are totally or partially determined by data outside
- *Output Interface*: fields whose value can be retrieved by outside
- *Internal fields*: fields that are totally determined by other fields in the same section, and cannot be seen by outside
Analysis of Section and Manipulative Structures (cont.)

• Fields in input interface, internal fields, and fields in output interface form a DAG (directed acyclic graph)
  – Fields in three domains (input/internal/output) may depend on each other. It’s not necessary that internal fields depend on output interface fields, and input interface fields depend on internal fields. So
  – Updates of fields may not be executed in the order of
    input interface $\rightarrow$ internal fields $\rightarrow$ output interface
  – Breadth First Search (BFS) is needed to do the updates.
  – Author of manipulatives/sections must be careful enough to not allow fields to form a loop
    • GeoSVG: detect dependency loop of geometric objects
    • Section composition: detect loop created by the dynamic calculator
Analysis of Section and Manipulative Structures (cont.)

• All the sections/manipulatives also form a DAG
  – If one input interface field of section1 depends on one output interface field of section2, we say section1 depends on section2.
  – The page authoring algorithm must not allow sections/manipulatives to form a loop of dependency
  – It’s not good to force a page author to compose sections with dependency in the order of their appearance.
  – BFS needed.
Analysis of Section and Manipulative Structures (cont.)

• Consider reusability of a section/manipulative in another page, we need to divide the expressions created by the dynamic calculator into two types.

• Expression attached to a field
  – page specific: expressions attached to input interface fields
    • Saved separately from the section/manipulative
  – class-wide: expressions attached to internal fields
    • Saved together with the section/manipulative
Analysis of Section and Manipulative Structures (cont.)

• SVG, Java applets, Flash based manipulatives need to notify the control module that its loading is done before the control module continues to render next section/manipulative.

• Manipulative development specification
Editors

• Editor for MathML in dynamic calculator
  – Javascript and MathML converter
• Html editor for composing education page
  http://www.dynarch.com/projects/htmlarea/
  – Good Open Source HTML editor you know
Future Work

• Based on the demos, work out a robust implementation of page authoring.
• Continue to work on GeoSVG manipulative authoring supports.
• Design GeoSite Web service to allow other sites to retrieve manipuatives together with sections.