Center for Active Learning of Microelectronics and Photonics

Java Applets as Learning Aids in Photonics

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Motivation

- Introduce Java Applets as supplementary instructional material
  - Extend the power of Java and the Internet to educational tools
  - Present information in a more visually appealing manner
  - Create a dynamic and stimulating learning environment
  - Address various learning styles in students

- Develop a supporting software framework that
  - Provides guidelines for developing ideal instructional tools
  - Follows good software design and development practices
  - Captures the experience of instructors and software developers
  - Helps instructors to effortlessly develop educational applications(Applets)

Teaching and Learning Styles

- To address various learning styles, instruction should
  - Introduce new concepts by building on fundamental principles
  - Help visualization of complex systems
  - Facilitate context based learning with demonstrations of real life scenarios
  - Encourage experimentation
  - Call for understanding information in a global context

Teaching and Learning Styles

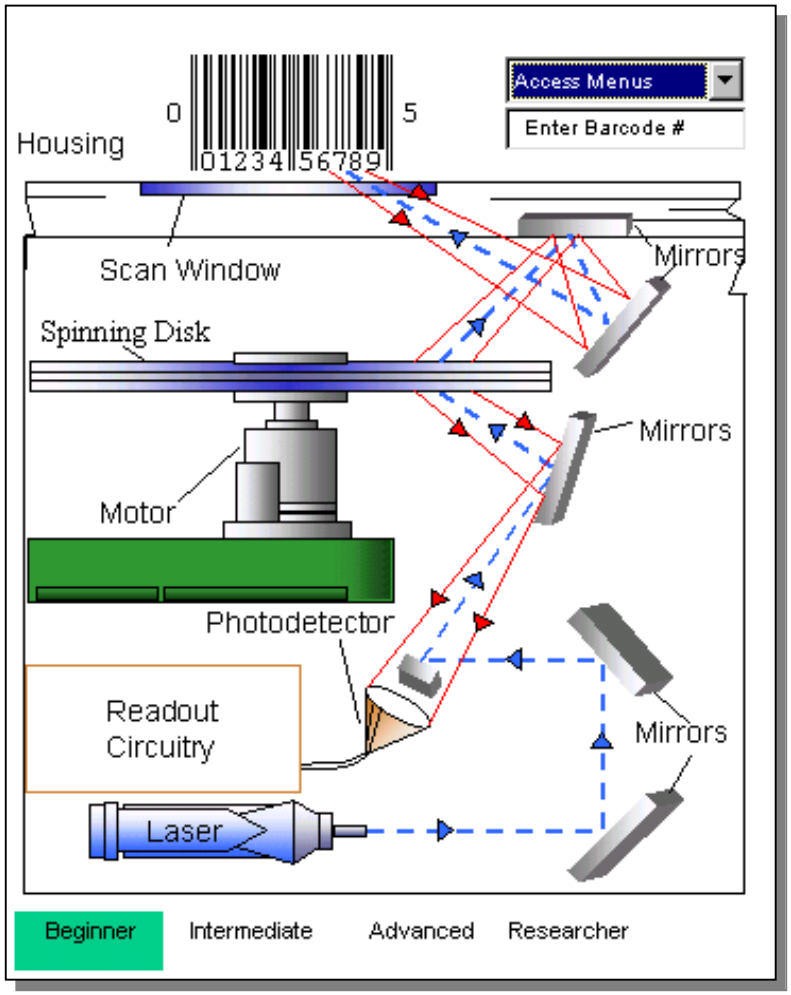
Preferred Learning Style		Corresponding Teaching Style	
Sensory Intuitive	*Perception*	Concrete Abstract	*Content*
Visual Auditory	*Input*	Visual Verbal	*Presentation*
Inductive Deductive	*Organization*	Inductive Deductive	*Organization*
Active Reflective	*Processing*	Active Passive	*Student Participation*
Sequential Global	*Understanding*	Sequential Global	*Perspective*

Dimensions of Learning and Teaching Styles
(Felder and Silverman (1988)).

Educational Java Applets and Learning Styles

- Educational Java Applets
  - Provide user configurable and data probing tools to help inductive style of learning
  - Promote global understanding of large-scale systems using context based case studies
  - Explain complex systems using vivid simulation schematics to favor visual learners

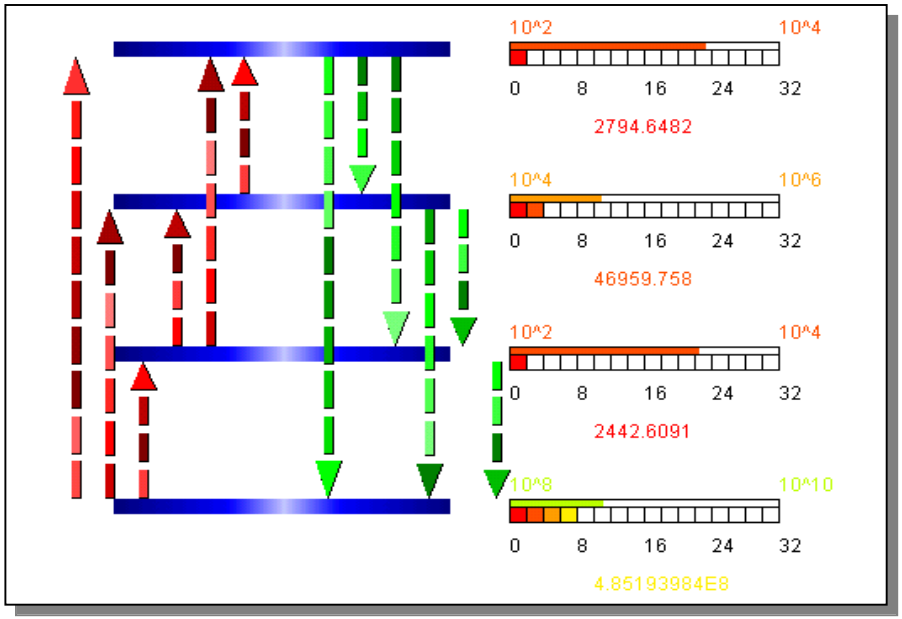
Bar Code Scanner



Educational Java Applets and Learning Styles

Gain Mechanism (Rate Equations)

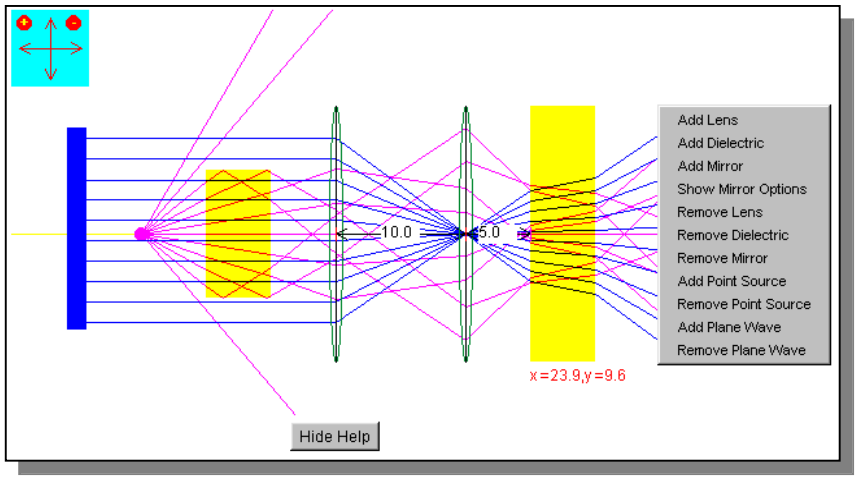
- Educational Java Applets
  - Provide helpful demonstrations of theoretical concepts
  - Provide virtual experimentation
  - Provide graphical interfaces to allow active learners to dynamically change the behavior of the system



Applets when used in conjunction with traditional lectures help approach an ideal teaching style

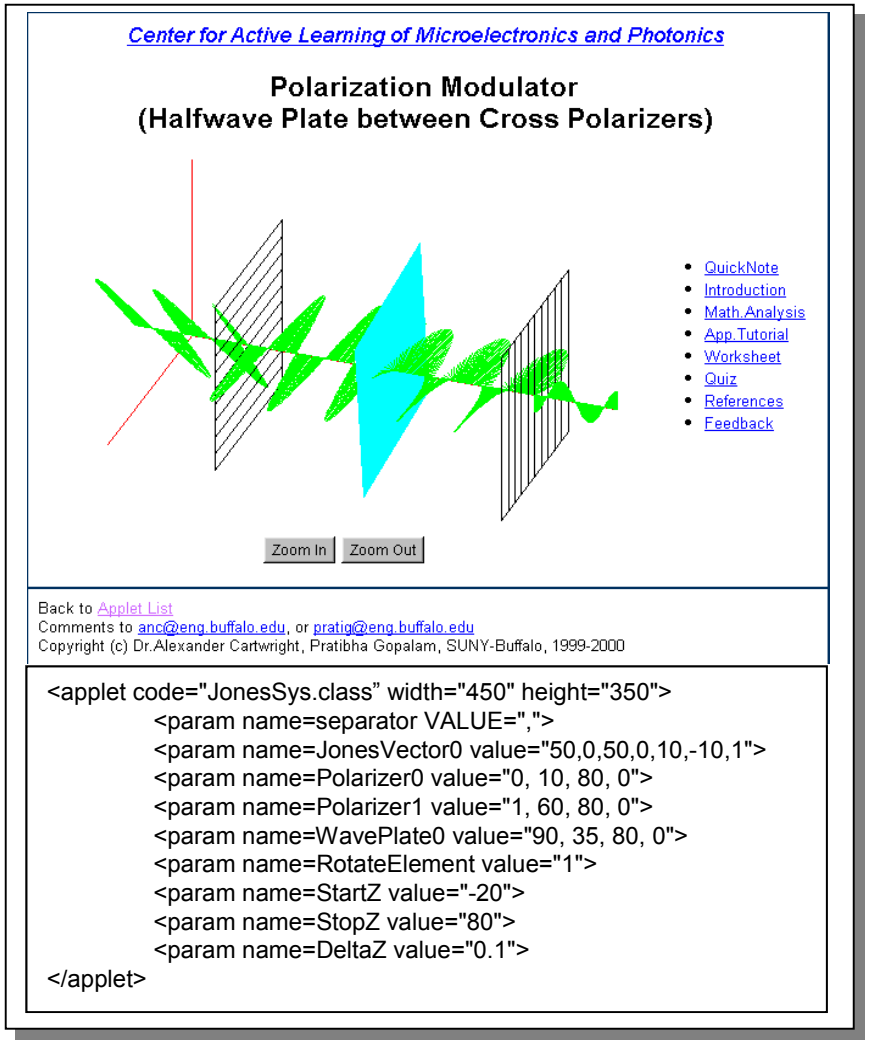
Examples of User Configurable Design Applets

Optical Design System



- Optical components
  - Graphically represented.
  - Menus used to dynamically change parameter values
  - HTML tags used to statically design systems
- Students are allowed to experiment with various configurations of lenses, mirrors polarizers and sources

Polarization Applet

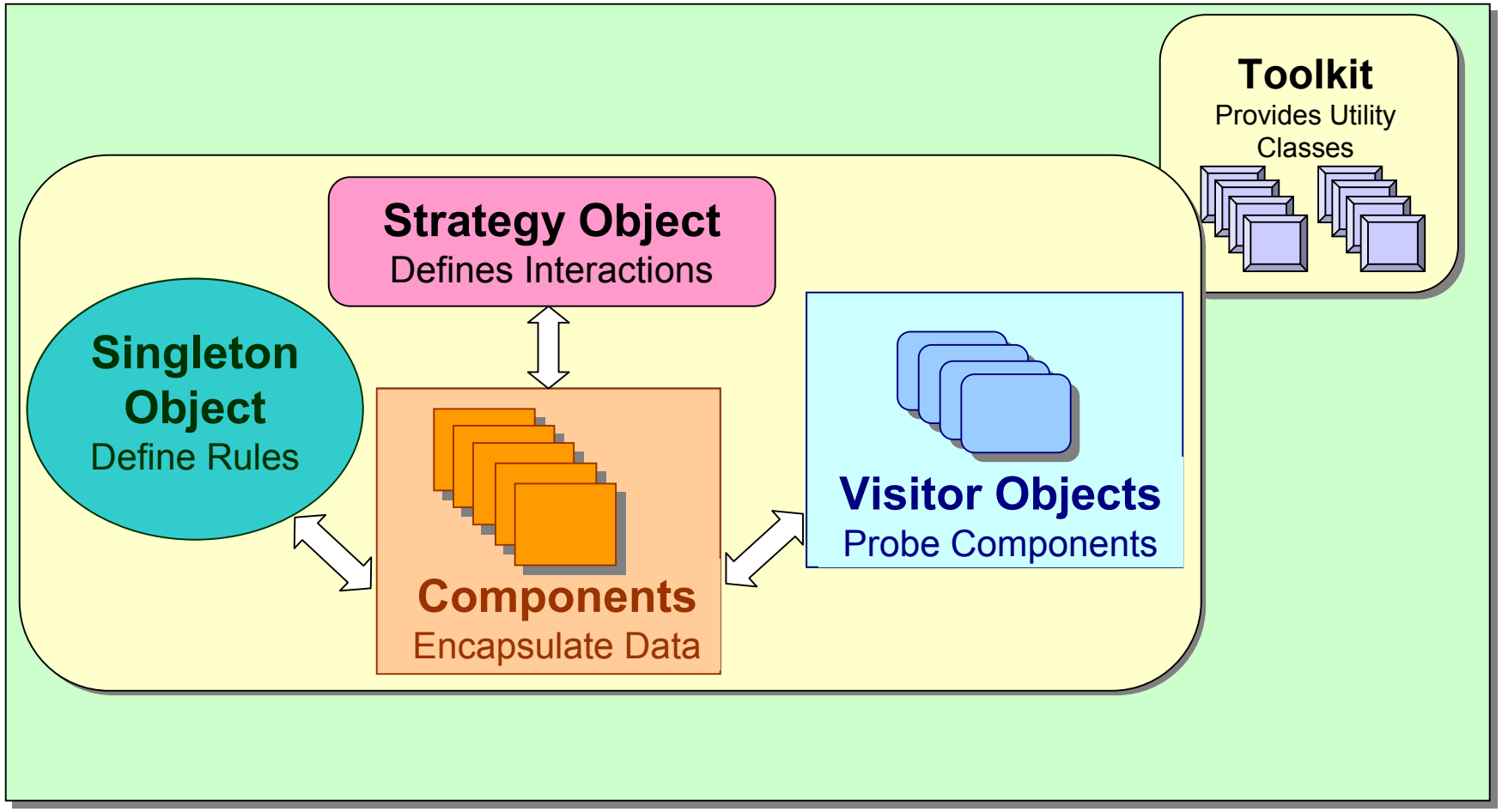



```
<applet code="JonesSys.class" width="450" height="350">
        <param name=separator VALUE=",">
        <param name=JonesVector0 value="50,0,50,0,10,-10,1">
        <param name=Polarizer0 value="0, 10, 80, 0">
        <param name=Polarizer1 value="1, 60, 80, 0">
        <param name=WavePlate0 value="90, 35, 80, 0">
        <param name=RotateElement value="1">
        <param name=StartZ value="-20">
        <param name=StopZ value="80">
        <param name=DeltaZ value="0.1">
</applet>
```

OOD : Design Patterns and Frameworks

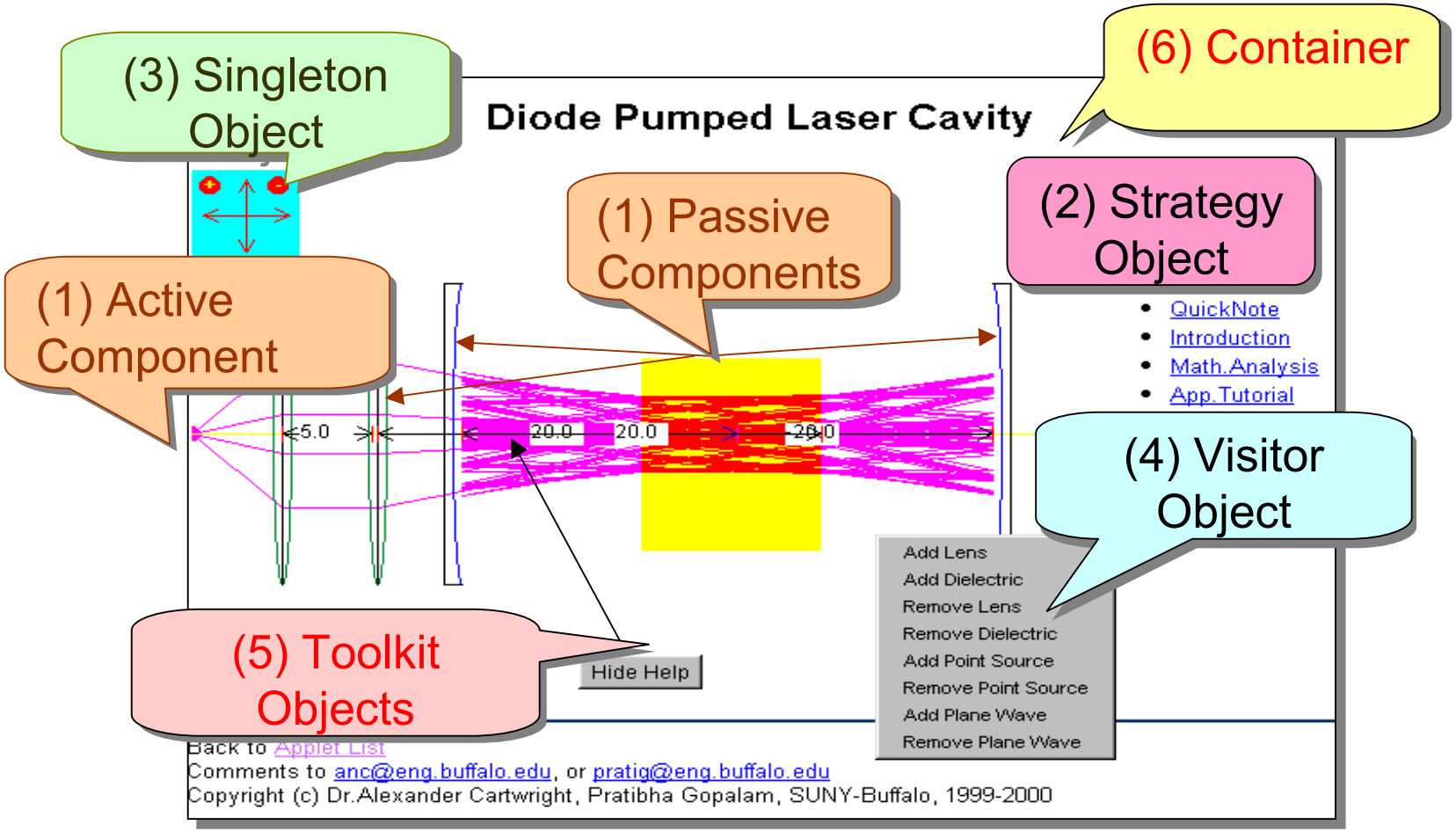
- Essence of true Object Oriented Software
  - Simplicity, Modularity, Reusability, Extensibility
- OO languages provide implementation support
- Design Patterns Provide:
  - Insights required for making reusable software
  - Experiences required for Robust and Scaleable solutions
- Frameworks
  - Collection of domain specific design solutions
  - OO reuse technique serving as the skeleton of an application
  - Reusable “semi-complete” application with built-in flexibility to transform itself into custom applications
  - Help in rapid, minimal effort, development of similar applications

User Configurable Virtual Laboratory Applets



Six Key Elements of the Framework

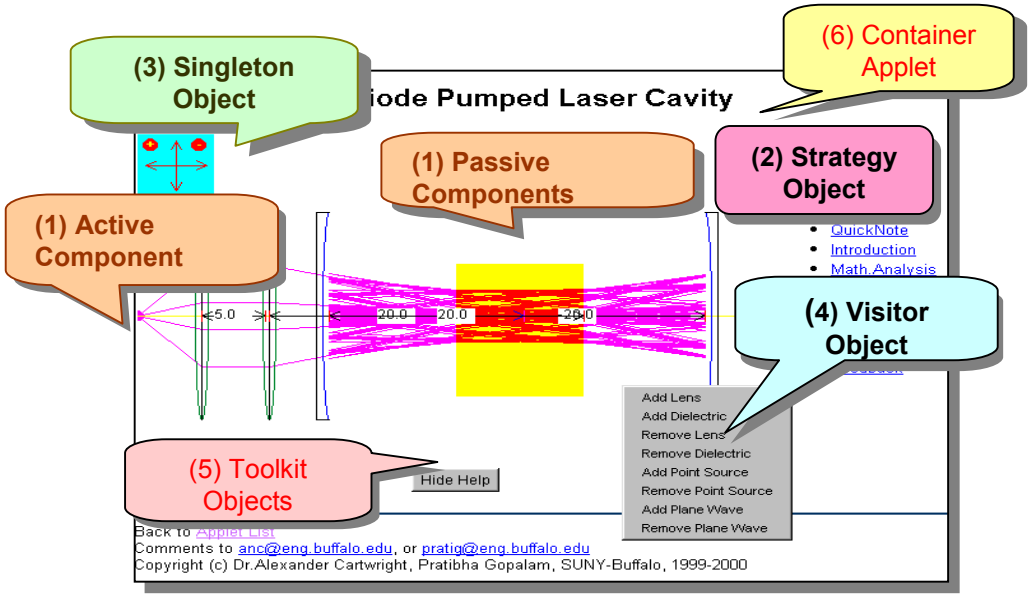
Example Implementation of the Framework



This Applet demonstrates a diode pumped laser system using ray tracing. Examples of the various elements of the framework are labeled

User Configurable Virtual Laboratory Applets

- Components
  - Encapsulate Data
  - Either Active or Passive
  - Typically have a graphical interface
  - Developers: Undergraduate students

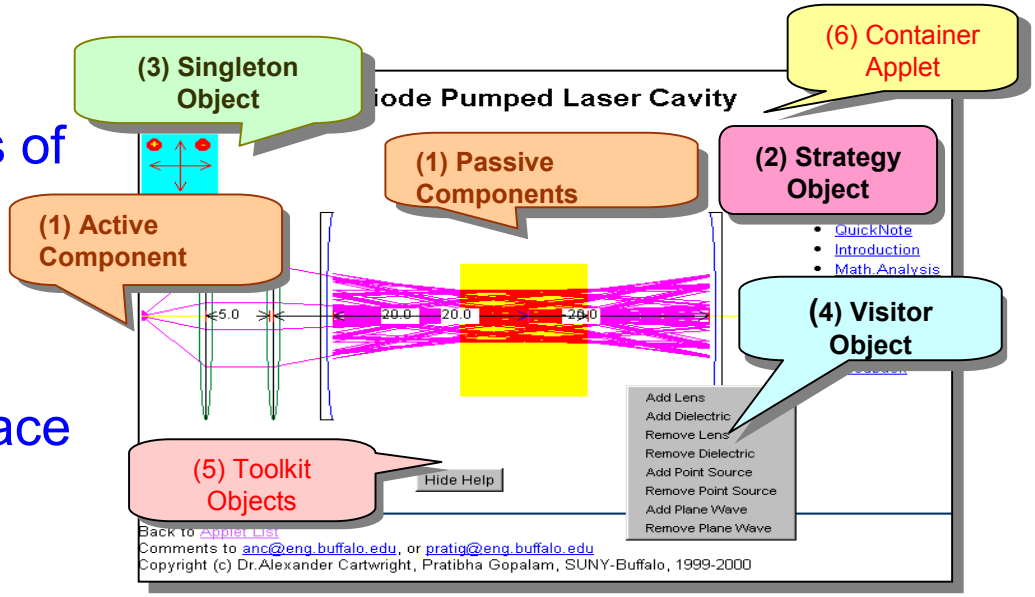


- Strategy Objects
  - Define governing principles for component-to-component interaction
  - Handle computational algorithms
  - Developers: Experienced programmers

- Singleton Objects
  - Define rules(units) for uniformity
  - Provide global access to rule information
  - Developers: Experienced programmers

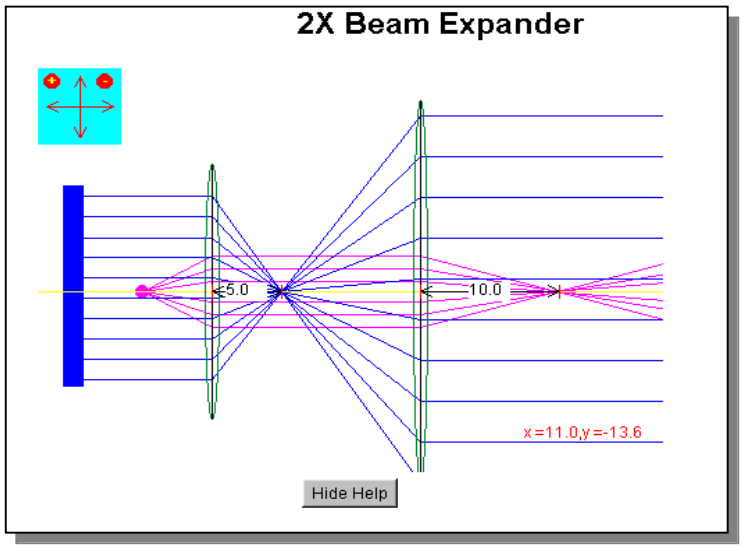
User Configurable Virtual Laboratory Applets

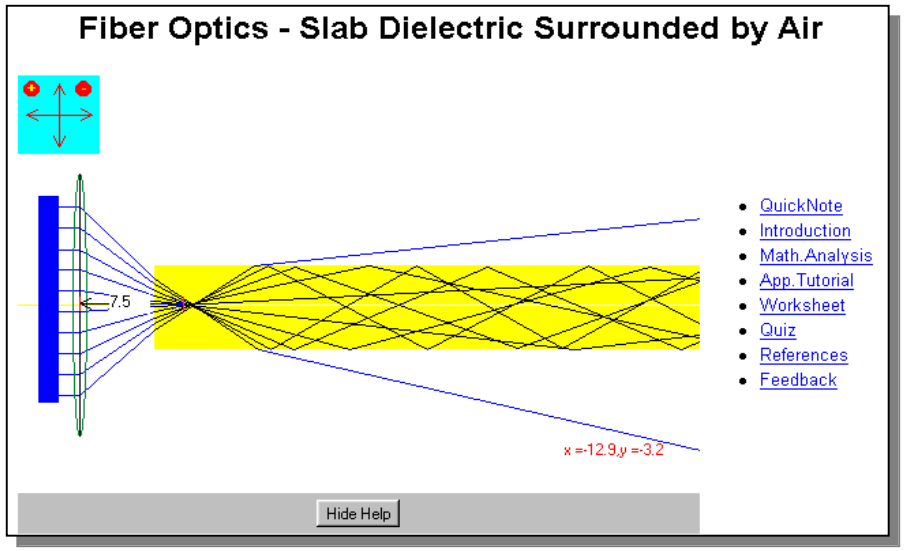
- Visitor Objects
  - Probe and change the status of components
  - Allow dynamic run-time configuration
  - Employ graphical user interface objects
  - Developers: Experienced programmers
- Toolkit
  - Comprised of utility classes
  - Evolve over time with new additions from users
  - Developers : Depends on complexity

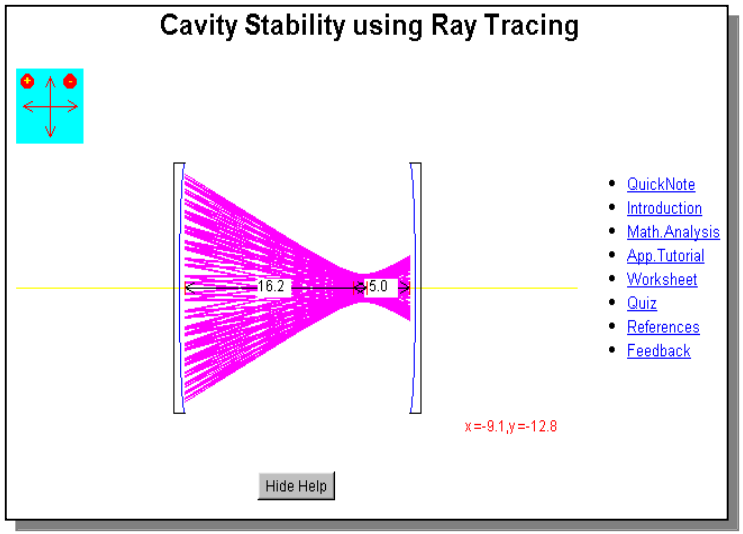


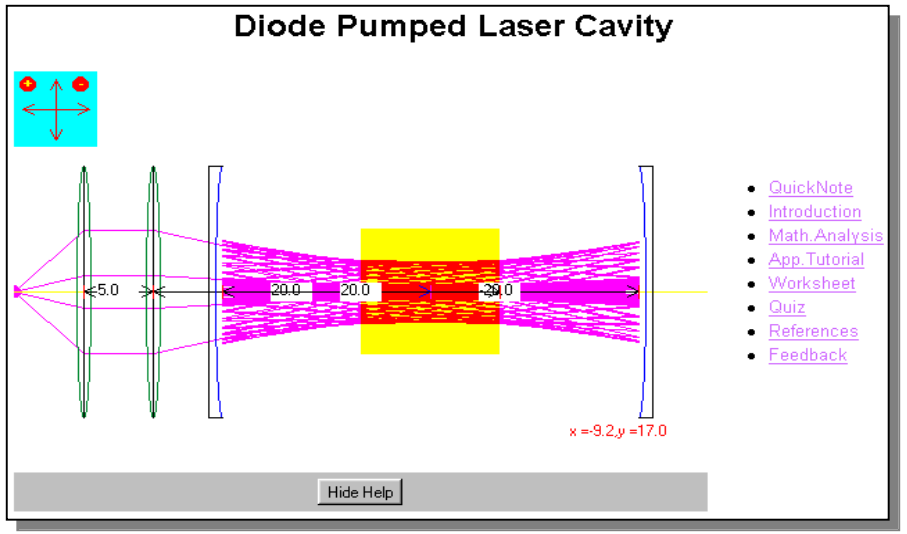
- Container
  - Placeholder for interdependent elements
  - Makes constituent elements aware of each other
  - Designer : Domain expert

User Configurable Virtual Laboratory Applets









Conclusions and Future Work

- Develop a generic, portable, set of objects for the proposed framework for use by other educators
- Standardize the development of user configurable virtual laboratory environments to serve as supplementary educational resources for various science and engineering subjects
- Adopt the software component technology using JavaBeans™ to further enhance the developed framework
- Supported by National Science Foundation Grant #9950794 (PI's: Chu R. Wie & A. N. Cartwright) and NSF CAREER Award #9733720 (A. N. Cartwright)