Visual Lab - A Multimedia Virtual Experiment Environment on WWW

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Abstract: This paper proposes an open architecture of Visual Lab on WWW and focuses on scientific experiment for the asynchronous mode of distance learning. Visual Lab is a virtual experiment environment by using video-media. A complete scientific experiment in Visual Lab includes four essential stages: phenomenon observation, experiment process observation, data measurement and experiment recording. In Visual Lab, students can carry out experiments remotely with the toolbox designed on Internet. A system architecture built on World-Wide Web demonstrates the feasibility and flexibility of our idea.
Keywords: Distance Learning, visual lab, scientific experiment, World Wide Web.

1. Analysis of Scientific Experiment in Visual Lab

For a full scientific experiment, there are several essential stages: *phenomenon observation, experiment process observation, data measurement* and *experiment recording*. These essential stages are analyzed details in the following.

Phenomenon Observation: With such knowledge, phenomenon observation can be divided into two categories
- (a) **Static Observation**.
- (b) **Dynamic Observation**.

Experiment Process Observation: It is very important to practice with one's own hands. After experimenting themselves, students can gain much impression.
- (a) **Traditional Process Observation**.
- (b) **Video Observation**.

Data Measurement: Data measurement is the key to prove a physics theory.
- (a) **Equipment Usage in a Traditional Lab**.
- (b) **Usage of Simulation Tools**.

Experiment Recording: The formats of experiment records have to be designed.

Problems Analysis of Four Essential Conditions on WWW: The formats of experiment records have to be designed.
- (a) **Video Format:**

	Compress	Network Transfer
MPEG	No	No
Real Video	No	Yes

AVI	Optional	No

Table 1: Video formats comparison.

(b) **Component Format:**

	Download	Security	Control Operation	Browser Support
Java Applet	Light	No	Can not access local files	Both IE and Netscape
Real Video	Heavy	No	Can not control	Both IE and Netscape
Window Object embedded in Web page	No	No	Can not control	IE
ActiveX	Heavy	Yes	Full control	IE
Application	Heavy	No	Full control	Both IE and Netscape

Table 2: Comparisons table of web technologies.

(c) **Experiment Record:** Students can record data what they want to measure and send out these data to teacher. Then teachers can gather all the student learning information via the function provided by experiment record.

2. Design the Platform of Visual Lab

In this section, several toolboxes will be discussed. Each measurement and observe components must applied these toolboxes in Visual Lab platform.

Measuring and Observing Tools: For a Visual Lab System, measuring and observing tools are helpful to both students and teachers

(a) **Video Controller:** To play some experiments video.
(b) **Scale:** In order to measure the actual length from the experiment video.
(c) **Ruler:** Students can adjust the length of this ruler tool to can get the length what they adjust when they saw in the video.
(d) **Protractor:** Students can measure the angular magnitude.
(e) **Calculator:** Students can input the data and get the result just like a calculator.
(f) **Timer:** A timer is needed to measure time in scientific experiment.

Components of Visual Lab: Each learning work is implemented by an independent component, and our architecture can be illustrated as (Fig. 1) shown.

3. Implement the Visual Lab on WWW

We designed a platform using open architecture technology. Our purpose is that all of the physics experiments can apply in Visual Lab without any modification. As long as teachers film the experiment and join in Visual Lab, students can experiment in Visual Lab environment and record with Microsoft Excel 2000, as show in (Fig. 2).

4. Conclusion

This paper proposes an open and reusable architecture of Visual Lab on WWW. All of the scientific experiments can apply to Visual Lab based on the architecture of Visual Lab had been accomplished. Learners can learn knowledge by experiment in the Visual Lab even they are not at school. Solution for transferring video stream through network should be the next research direction to enhance Visual Lab.
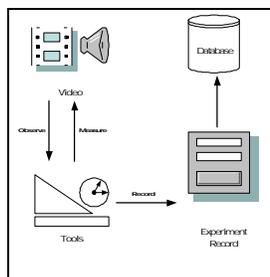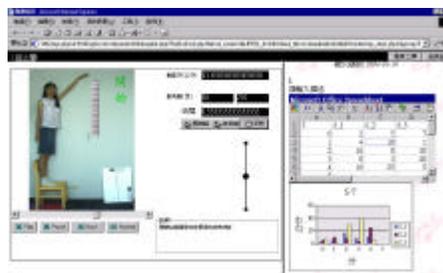

Figure 1: The architecture of Visual Lab.

Figure 2: Scientific experiment