INVESTIGATION OF VIDEO SYSTEM IN PARALLEL CLASS

Aditya Rama Mitra
Universitas Pelita Harapan, Lippo Village, Tangerang
aditya.mitra@staff.uph.edu

ABSTRAK
Makalah ini melaporkan hasil investigasi terhadap sistem video yang diimplementasi pada sebuah tatanan kelas paralel yang ada. Sistem video dalam kelas paralel ini berperan dalam mengakomodasi kebutuhan komunikasi visual antara pengajar yang berada di kelas induk (master) dan para peserta ajar yang khususnya menempati ruang-ruang anak (dependant). Dalam implementasi ini sistem video yang digunakan adalah sinyal analog berupa video komposit dalam format PAL (Phase Alternating Line). Serangkaian pengujian yang dilakukan memperlihatkan bahwa secara keseluruhan sistem video yang ada tidak menunjukkan adanya artifak potensial karena kombinasi sinyal dalam format video komposit itu sendiri. Sekalipun kualitas S-Video lebih baik dari video komposit, namun pertimbangan migrasi ke S-Video tidak saja melibatkan pengkabelan ulang, namun juga penyesuaian kamera, yang saat ini digunakan untuk dapat mengalirkan sinyal melalui koneksi S-Video dan pengadaan pengatur sinyal S-Video, untuk kamera di kelas-kelas anak. Dengan pertimbangan biaya investasi dan ketersediaan peralatan dengan koneksi S-Video, pilihan terbaik adalah mempertahankan sistem yang ada dengan melakukan improvisasi seperlunya.

Kata kunci: Kelas Paralel, Sistem Video, Video Komposit

1. Introduction

In parallel classroom (Figure 1) where the observation reported here is held, the visual communication between the teacher occupying the master classroom and the students sitting particularly in dependant classrooms is accomodated by the use of video cameras. These CCTV cameras are installed in the classrooms and connected to a camera controller located in a control room via regular video cables. This video system being concerned is actually based on a PAL (Phase Alternating Line) composite video signal (CVBS).

Conceptually, a parallel class comprises of a number of classrooms connected together to build one single large classroom virtually. In practice, this class setting exercises a face-to-face synchronous learning mode. To support the need for communication between classes, the presence of a well integrated sound system and the use of visual communication devices are by all means significant.

On the choice of video format, this issue is much influenced by the fact that composite video is widely used and has been around for years in the market[5]. The second popular reason is due to its low cost implementation. Despite its popularity, composite video gives the lowest quality of images compared to other formats such as S-Video, component, RGBHV, and so on[4], as the use of comb filter to separate the compressed signals (luminance, chrominance, synchronization) may result in degradation of signal quality[1]. The combined signals may arise a potential problem in regards to image quality which is recognized as artifact by the audience. Three of these artefacts are dot crawl, Moire effect and color smear.

Figure 1. Parallel Class Consists of One Master Class With Four Dependant Classes
This preliminary effort is aimed at identifying potential problems found in the environment of parallel class video systems based on composite video signal and obtaining a better ground for proposing necessary improvement when significant video problems are identified or when necessary, migrating to better video systems.

2. Method
To obtain a better picture of the current system and achieve the observation’s goal, this investigation holds an onsite observation (in B-210 cluster at UPH), performs subjective test which is merely based on what user perceives (Figure 2), analyses the observation by comparing its result with the references, and draws conclusion from the findings obtained.

To compare the captured image with its reference, a proposed model is presented as illustrated in Figure 2. This model is introduced due to the problem arise with the consistent evaluation of what audiences actually perceive when they see the display on the screen. The limitation of human visual memorization clearly provides no support for describing consistently what they have seen using different representation at different moment. However, the model introduced here indicates an important shift of the motive, i.e. from direct to indirect observation using a series of picture captured by a computer software through a TV tuner card.

![Figure 2. Proposed Model of Subjective Test](image)

Working with the digital pictures as the chosen representation of the display, once these objects are taken then they are ideal for later evaluation in the sense that they are not affected by the exterior or interior lighting. In fact, the light intensity of interior light source as well as exterior lighting which penetrates classroom varies from time to time and at certain level, this lighting may impact what one perceives about the display as it appears on the screen.

3. Discussion
3.1. Composite Video
Two of common analog television encoding systems used widely around the world are PAL (Phase Alternating Line) and NTSC (National Television System Committee). Basically, NTSC and PAL are very similar. Both use composite video baseband signal which is formed from a quadrature amplitude modulated subcarrier carrying chrominance information and luminance video signal. The waveform of a PAL composite video comprises of many parts including horizontal and vertical synchronization pulses, horizontal and vertical blanking pulse and special signals that are wrapped in one wave signal. To create color on the display, PAL video signal uses 4.43 MHz chrominance subcarrier which is added to the video signal[6].

3.2. Artifacts of Composite Video
As mentioned in previous section, composite video signal is prone to potential artifact arises due to the crosstalk[2][3]. In fact, this phenomenon is the primary cause of defects such as color smear, dot crawl, and Moire effect.

Color smear causes the color to be incorrectly placed, i.e. the color spreads to other area. Dot crawl creates a dot composition in the border of two different color areas. Moire effect may appear on the finely textured image as another similar pattern is superimposed to the image. Besides these artifacts, other potential problem is related to bad grounding of video equipment devices being in use create a hum bar. This is easily noticed as scrolling horizontal lines moving from bottom to top, or the other way around, of the display screen.
4. Result

4.1. Test Scenario
The subjective test is conducted based on three scenarios (Figure 3 and 4). For completing this test, video generator, video stabilizer, video splitter, upconverter and scan converter are involved. Besides, a TV tuner card is needed to capture the signal sent by the source and save it as a digital image.

In the first scenario, the signal travels the shortest distance between the signal source and visualizer where the video generator (as signal source) is connected directly to the projector. The second scenario inspects the signal sent by the source (i.e. video generator) at the longest distance from the visualizer in cluster B-210. The last scenario compares the quality of the display produced using video stabilizer with the one produced without stabilizer; the quality of S-Video signal is also compared to composite video.

4.2. Test Result
The following table summarizes the test result involving only a portion of all test patterns involved (Table 1). The table compares the display produced by the projector, monitor screen, and the reference. The capture column presents the three tests represented by the images captured digitally based on three scenarios as mentioned previously.

4.3. Analyses
Using scenario #2 the result indicates that the distance does affect the display quality as observed by slightly discolored images. The use of a distribution amplifier may solve this problem.

Scenario #3 gives a better result than scenario #1 in which a video stabilizer and S-Video signal are used to deliver content. This result reaffirms that S-Video signal is better than composite video.

Using test pattern number 0 defined by the video generator, which is applied to synchronize the video device, one will see nothing on the screen. But when captured using a computer then the audience will see a black screen. This is interesting as audience will have a different perception when the video is dominated by dark color.

Performing test pattern number 55 to detect the existence of hum bar (scrolling lines), the captured image shows no defect of this type. While applying test pattern number 71 which is related to the aspect ratio of the video device, it is interesting to see that scenario #1 and #3 show elliptical images after adjustment.

<table>
<thead>
<tr>
<th>Pattern #</th>
<th>Test pattern</th>
<th>Redescr</th>
<th>Display on screen</th>
<th>Captured image</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Black/gray</td>
<td></td>
<td>(1)</td>
<td>(1) (2) (3)</td>
<td>Synchronizer not working; Check for error in cable.</td>
</tr>
<tr>
<td>1-9</td>
<td>Video bars</td>
<td></td>
<td>(1)</td>
<td>(1) (2) (3)</td>
<td>Check the capability of the device to create fully saturated red, green and blue; check video and TV receiver.</td>
</tr>
<tr>
<td>55</td>
<td>Horiz bars</td>
<td></td>
<td>(55)</td>
<td>(4) (5) (6)</td>
<td>Linear and vertical lines, check signal levels and gain/phase.</td>
</tr>
<tr>
<td>71</td>
<td>Aspect ratio</td>
<td></td>
<td>(57)</td>
<td>(4) (5) (6)</td>
<td>Adjust the aspect ratio of video monitor; adjust the contrast (50% and 100%) and the color of the image.</td>
</tr>
</tbody>
</table>
5. Conclusion
To conclude the discussion:

a. Overall, no significant potential problem (dot crawl, Moire effect, color smear, hum bar) is detected in the existing system.
b. The distance travelled by the signal as transmitted by the video source affects the quality of the display at the destination. The longer the distance, the weaker the signal is. This needs the presence of distribution amplifier.
c. No significant delay found in the remote transmission which theoretically may cause the display not horizontally and vertically synchronized.
d. The test performed using some number of test patterns as generated by the video generator indicates that the quality of S-Video is better than the composite video format. Nevertheless, the limited range of travelling distance of S-Video signal over a cable without the use of distribution amplifier, higher cable cost, and many adjustments should be made for existing composite-video-based video devices provides not enough reason to migrate to S-Video[3]. Thus, the option would be maintaining the existing video system.

6. Further Exploration
For gaining a better result, a better model of subjective observation can be designed to capture what audience perceives about the display generated by projector which is to be contrasted with what the camera sends to the projector.

References