

Novel Software Architecture for Surveillance Video Processing

Timothy F. Gee, MS*, Thomas P. Karnowski, MS, Kenneth W. Tobin, PhD, and Jeffery R. Price, PhD, Image Science and Machine Vision Group, Oak Ridge National Laboratory, Bethel Valley Road, Oak Ridge, TN

Learning objective: to present to the forensic community the architecture design of a software environment for surveillance video processing.

This describes the organization and capabilities of the Video Tool for Aiding Law Enforcement (VITAL). Included in the presentation will be a demonstration of the VITAL software. VITAL is a software program that can be used for restoring and enhancing surveillance video. It was developed by the Image Science and Machine Vision (ISMV) Group at Oak Ridge National Laboratory (ORNL) to offer video analysts a new work environment as well as new algorithms for processing video. VITAL is organized in a novel architecture that makes the video analyst's task easier and offers several unique capabilities, making it a model application for surveillance video restoration.

In the VITAL environment, cases are handled as application projects. Projects are initiated by entering case and investigator information and then selecting a sequence of video that has been previously digitized outside the VITAL environment. The sequence is then pre-processed to handle any formatting issues associated with the video's storage protocol. At that point, the project's data can be restored or enhanced using a number of video and image processing algorithms made available in the VITAL environment.

The interface and processing is completely oriented toward the handling of video sequences. This differs from many basic image processing applications that handle individual images one at a time. In the user interface, video sequences are displayed using a combination of an Animator window and a Browser window. The Animator window displays the sequence as a movie in which the speed can be varied or one frame can be viewed at a time. The Browser window displays the video similar to a filmstrip in which thumbnails of many sequential frames can be viewed at once. The Animator and Browser window are always together for viewing a particular sequence, and the frame that is active in the Animator is highlighted in the Browser, so they are always synchronized as well. Although one image is highlighted as the current frame, any processing operation that is chosen from VITAL drop-down menus will be automatically performed on all frames within the sequence. In some cases there is a preview mode in which the current frame is used for iterative selection of processing parameters, and then once the parameters are chosen the sequence is processed in its entirety.

While the VITAL environment is very structured and is able to track all operations performed on a sequence, it still allows and encourages experimentation by the analyst. Once a video sequence is brought into the environment, a number of different analysis sets can be made from part or all of the video sequence frames. In fact, a processing chain can be separated into multiple branches at any time. This allows the analyst to try different approaches in parallel and disregard the results from less successful branches. Each analysis set has a current video sequence that is displayed through the Animator and Browser window pair. These windows can be used to view multiple analysis sets at once, or the analyst can hide sets that aren't currently being considered. After a processing step has been performed on an analysis set of video, the analyst is presented with an Animator and Browser window pair for both the before and after video sequences so they can be viewed at the same time. Then the user is asked whether or not to replace the current video with the new results.

During processing, the steps and parameters are automatically recorded by the software, making it easy for the analyst to document and later repeat any processing steps. Also during processing, the analyst is able to enter any comments to clarify analysis objectives or record observations. Once the processing of a case is complete, the analyst can command VITAL to write a HyperText Markup Language (HTML) document that will contain all case information, notes, and processing parameters. The document can also contain original, intermediate, and final imagery. The benefit to creating a report in this fashion is that the entire report can be written to digital media, such as a compact disc, that can then be copied for documentation or delivery to law enforcement and court personnel. This reduces costs, simplifies procedures, and ensures a high-quality representation of resulting imagery.

Surveillance Video Processing, Video Restoration, Video Enhancement, VITAL