Title
Keeping Manga video summaries of different sizes consistent

Brief description
This addresses the problem that Manga video summaries of different sizes can use very different keyframes. That is visually confusing when a user changes the size of a Manga video summary. For video content owners who present their content as Manga summaries, this generates uncertainty of what users viewing those summaries on different display sizes will see. This uncertainty prevents the attachment of additional information to certain keyframes because those may not be shown in some summaries.

The solution is to use all keyframes from a smaller summary in a larger one and to select additional keyframes for the larger summary. Importance scores from the smaller summary are propagated to the larger one to keep image sizes similar.

Problem definition
Manga video summaries of different sizes can use very different keyframes. That is visually confusing when a user changes the size of a Manga video summary. For video content owners who present their content as Manga summaries, this generates uncertainty of what users viewing those summaries on different display sizes will see. This uncertainty prevents the attachment of additional information to certain keyframes because those may not be shown in some summaries.

A previous solution of specifying a set of keyframes that have to be included in the summary is cumbersome for the content owners. Also, it still does not maintain visual consistency of keyframes that are not in that set.

Flowchart
The yellow boxes in the flowchart indicate the steps of the algorithm described here. The other steps are part of the old algorithm.
Key Concepts

As previously described in [Uchihashi 1999], the Manga video summary algorithm determines a natural number of clusters. The video is then segmented such that each uninterrupted sequence of video frames belonging to the same cluster forms a segment. Segments are assigned an importance score as described in [US 6,535,639]. For a given display area, the most important segments are used, one keyframe is selected for each of the segments, and then assigned a display size relative to the importance score. The layout algorithm creates a packed layout optimized such that only a few keyframes are displayed in a size different from the assigned one [US 7,275,210].

When more keyframes are needed for the display area than the natural number of segments, the number of clusters is gradually increased until there are a sufficient number of segments. A segment that was represented by a single keyframe in a small display area may be split and be represented by several keyframes in a larger display area. It is even possible that the split segments would each be assigned a much lower importance score so that they would not be represented at all. At the extreme, a very important segment represented by a large keyframe in a small display area may not be represented at all in a large display area.
The natural keyframes and importance scores of the natural set of segments are stored. The video is segmented for a larger number of segments as described above. If a keyframe from the natural set is contained in a segment, the keyframe and its associated importance score is assigned to that segment. For all other segments, importance scores and keyframes are assigned as before. The importance scores for the latter segments are scaled such that the greatest of those importance scores is less than the least of the importance scores of the natural keyframes. Next, sizes are assigned to the keyframes determined by the two different methods relative to the importance scores. Finally, the layout is determined from the assigned sizes as before.

Keyframe sets for different large display areas may not be subsets of each other. However, the intersection of those keyframe sets would be the natural set of keyframes. Those keyframes are assigned the largest size so that the difference in the remaining keyframes would be less noticeable due to their small sizes.

Figure 1. Small layout (same), old large layout, new large layout

Figure 1 shows examples of a layout with fewer than the natural number of keyframes and larger layouts generated with the two different approaches. One can see that only 5 of the 12 keyframes in the small layout on the left are used in the large layout in the center produced by the old approach. In contrast, the large layout on the right produced by the new approach includes all 12 keyframes. Due to layout constraints, even the new approach cannot preserve the sizes of the keyframes used in the small layout with two being reduced in size and five being increased in size. The tendency to increase the size of some keyframes is inherent in this approach because the additional keyframes are intended to be smaller than the reused ones.

References