Design of Applications, Service and Systems

Project name:
Neuro-load reduction on video stream for kids

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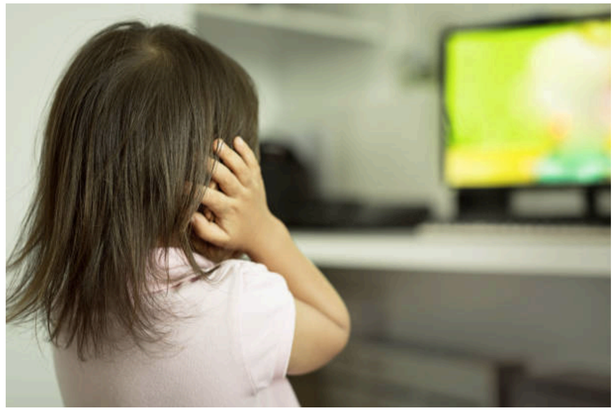
Overview

Because there is a limited capacity for storing information in the working memory, high levels of cognitive load can inhibit kids attempts to transfer unclear or excessive information from the working memory to the long-term memory. Therefore during watching a movie or cartoon specially those which has fast scene transitions would cause some sort of attacking on kids brain and make them unaware of what happing around them.



How Do We Process Information?

- Information from your sensory memory passes into your working memory, where it is either processed or discarded. Working memory can generally hold between five and nine items (or chunks) of information at any one time. This is central to Cognitive Load Theory, as you will see.

- When your brain processes information, it categorizes that information and moves it into long-term memory, where it is stored in knowledge structures called "schemas." These organize information according to how you use it. So, for example, you have schemas for different concepts such as dog, cat, mammal, and animal.

- You also have behavioral schemas for actions like hitting a ball, riding a bicycle, ordering food at a restaurant and so on. The more practiced you become at using these schemas, the more effortless these behaviors become. This is called "automation." Schemas are also significant to Cognitive Load Theory. Let's find out why.

What Is Cognitive Load Theory?

"Cognitive load" relates to the amount of information that working memory can hold at one time. Sweller said that, since working memory has a limited capacity, instructional methods should avoid overloading it with additional activities that don't directly contribute to learning. This is also true when you are watching a movie with a very fast pace of scene changes in which you can’t follow the movie because of working memory capacity limitation.

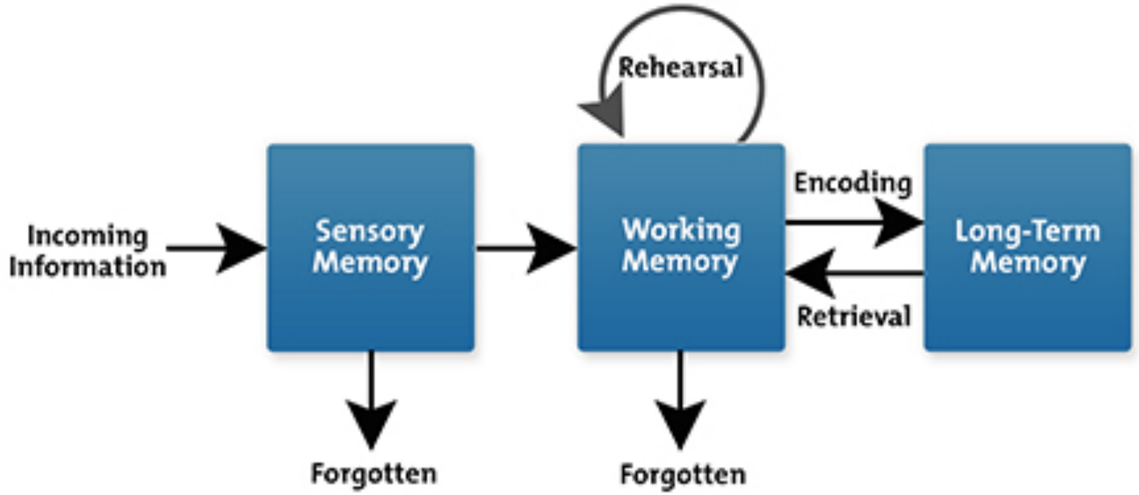


Figure 1: Information Processing Model

Applying Cognitive Load Theory to Video Streams

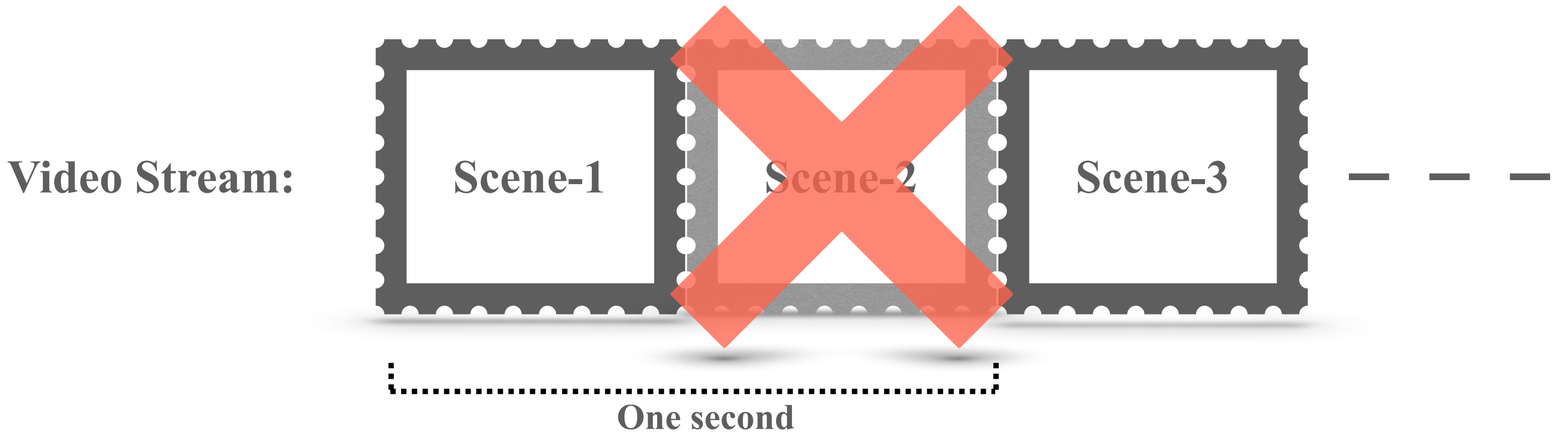
The concept of Cognitive Load Theory helps us to design applications which will reduces the demands on kids' working memory, so that they watch and learn more effectively. You can apply the concept of cognitive load to movies or cartoon in several ways.

- **Reduce the Number of Scene Changes**
- Reduce the Problem Space
- Reduce Split-Attention Effect
- Take Advantage of Auditory and Visual Channels in Working Memory

*In this project we will use the first method which is reducing the number of scene changes on video streams

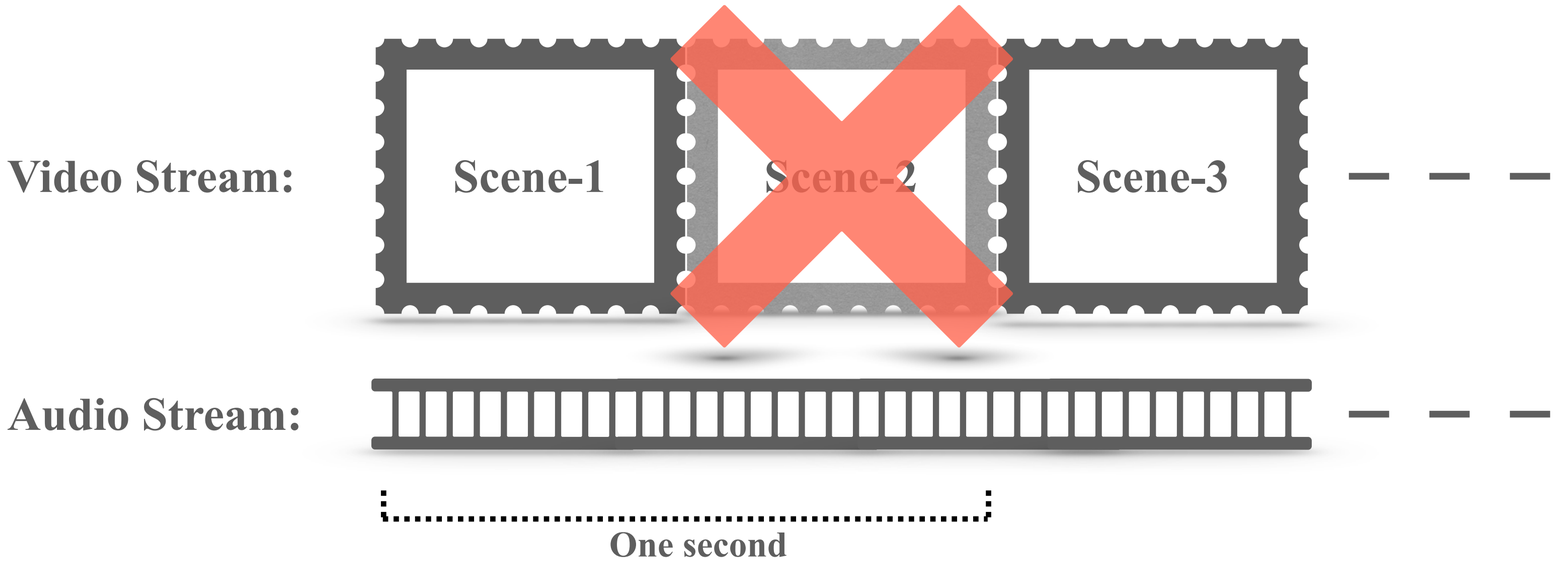
Reduce the Number of Scene Changes

Take a look at trailers or cartoons or sports then you will realized that how fast scene changes occurs. Specifically, in trailers you can usually see more than two scenes per second which easily causes overloading on children brain.
By reducing the number of scene transition on video streams based on a certain threshold you can prevent or at least reduce cognitive overloading on their working memory.



Reduce the Number of Scene Changes

- One constraint is time continuum, since the audio track need to be maintain intact during the whole stream.



Reduce the Number of Scene Changes

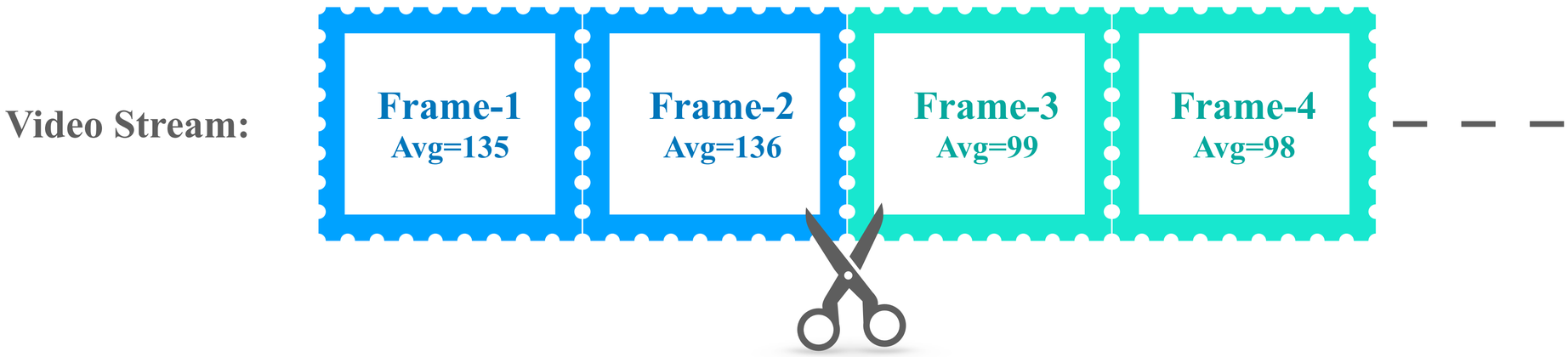
Steps which is needed to accomplish this technique:

1. Detecting all the existing scenes in the stream
2. Defining a constraint on the number of reduction based on a threshold
3. Devising different methods for replacement of removed scenes

Detecting all the existing scenes in the stream:

- Compute the pixel average of each frames and then compare each of them with their next frame. If the differences are above a threshold it means there is a scene change.

- Example: you can see from frame1 to frame2 average difference is 1 but from frame2 to frame3 it is 37 which means we have a scene transition.



Defining a constraint on the number of reduction

When we detect total number of scenes in the video stream, then we need to decide how many of them to be shown and how many of them to be removed.
We might decide to add a threshold based on the number of scene per second or per minutes.

- remove those scenes that have less than a second presentation time.
- decide how many scene should be shown per minute.

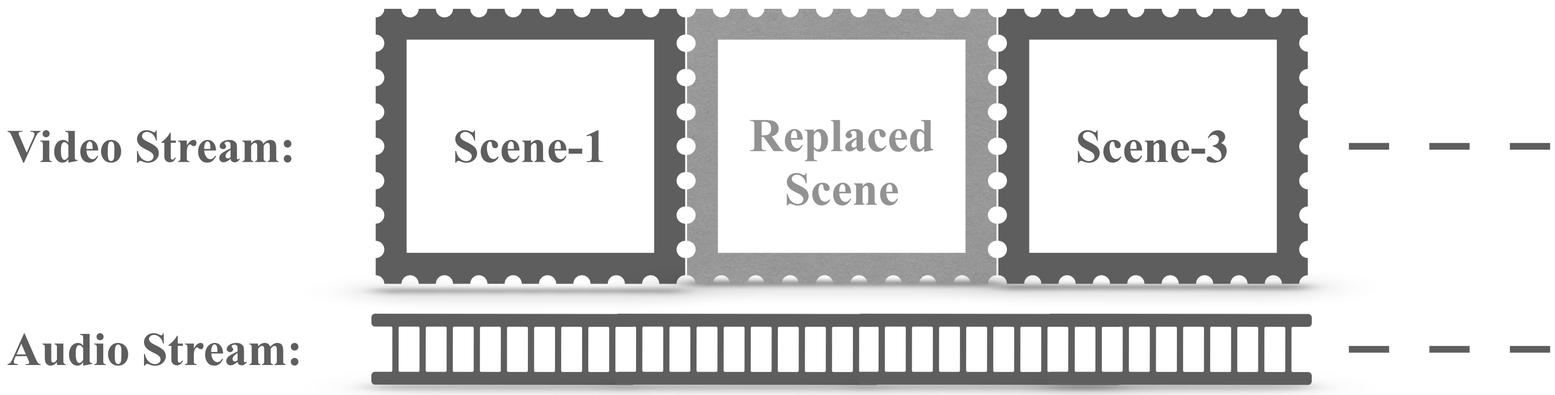
Methods for replacing the removed scenes

When we detect some opportunities for removing scenes, then we need to decode what technique to use for replacing removed frames.

- Replace the removed ones with black/white frames
- Freeze the first frame of the removed scene
- Freeze the last frame before the removed scene
- Freeze the next frame of the removed scene
- Blur the removed scene
- Blur the last frame before the removed scene to the next frame after removed scene
- Fade the last frame before the removed scene to the next frame after removed scene
- fade the removed scene to the next frame after removed scene

Synchronization

Finally, when we are done with the video then we can attach it to the audio track which is remain intact:



Future works

- Devise a better scene detection technique to identify scene transition. We might need to use some computer vision techniques like object detection to identify the scene changes more precisely.
- it is not very efficient to remove a scene without considering the importance of it. We might need to devise a technique to identify those scene which are less important.
- We might need to remove some less important objects of the scene and keep those critical part of the scene.