Fall 2020 CSCI 576 Multimedia Project

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Demo date: Thu Dec 3rd and Fri Dec 4th, 2020 – demo timeslots will be assigned.

The course project is meant to give you an in depth understanding of some of the areas in multimedia technology. Since this is a broad field, there can be a variety of interesting projects that can be done depending on your interests which can also extend to related and complementary topics that are taught in class.

Also, I have often found that a large project can be successfully accomplished via collaboration. Additionally, working together to design and integrate code can be a rewarding exercise and you will frequently need to work in teams when you set out to work in the industry. Accordingly, please form groups of exactly two or at the most three students. We have started a discussion board to help you make groups, where you may post your preferred language of implementation, availability etc. Once your group is decided, please send the TAs an email so we can assign a time for demo on the due date. If you are a remote student and are having trouble finding a partner, please send an email to the TA/me and we will try to help. Also, if you are a remote student, we normally allow you to do a remote demonstration. Details on this will be decided soon.

This semester, I have proposed a project in the area of implementing multimedia queries. The motivation, description and the expectation for the project follows on the next page.

Extracting Multimedia Descriptors for Search/Indexing

Text based searching today has become a natural part of how we access information and there are many ways to search and rank textual information. For instance, you can search using a specific text string query while browsing a big text document and just as easily bring up other documents that contain the same query text string. Search engines like google, bing, yahoo etc. enable you to search the whole world wide web of textural web pages for specific strings and rank them in an order of importance using various classes of search algorithms.

Now with the advances in inexpensive digital video (and audio) capture devices, media data is commonplace now. There is a lot of digital video information everywhere – streamed to you via the internet and cable networks, hosted on websites and social media networks, your own personal hard disks etc. With a lot of video/audio/image information, there needs to be a search paradigm to make sense of it. However, the search paradigms and methodologies for media data are as well formed and are still related to text information and/or metadata that is annotated around the media data.

Rather than using text to query media, another natural paradigm might be to use media itself – for instance given short video clip, you want to search through an entire database of videos to find the video which contains the “same” query or “similar” content as in the query clip. The motivating question here is - what is involved in developing a system that takes a short video clip as input and very quickly produces a ranked list of videos (from a database) that either contains the queried short clip or contains similar queried short clips. This is no doubt a complex problem with many nuances to consider but is also a practical and useful problem that needs a solution. Although this is a hard problem to solve for all general cases, for the purpose of this project we will constrain problem space well enough with easier datasets so that you can get results that should be rewarding.

You will be given a list of folders each specifying a category. The categories you will be given are sports, interviews, movies, advertisements, animated moves and orchestra. Each folder or category will contain video files (with their corresponding audio files). For simplicity, all the videos will be of the same image size, same number frames and format. You will need to develop an *offline* process that will query these videos in each category and extract *multimedia semantics* and use them to create descriptors based on principles that we have learned in class (or other ideas that you might have). This is an offline process, so run time is not a issue but correct rich descriptors are going to be helpful. You will also need to develop an *online* program that will take a query video (examples will be provided) and create a list of matched videos which contain the “same” or “similar” query. You will need to develop a user interface that will show the query video and the list searched videos produced by your program and play the video/audio upon selection. Consequently, there are three big parts to this project detailed below

Offline process to extract video/audio semantics:

This is an offline step that should be run prior to running your query. You can analyze all the frames of video and audio for every file and extract semantics that will help you run a query. These could be quantitative measures based on concepts learned in class. Suggestions are listed below, please give thought to how you would extract them, and organize them to be used for searching. You are not limited to using these, and may think of creating descriptors based on other metrics.

- Color – For every video you can find a color theme. Eg extracting the most dominant colors per frame as a list of numbers and collating this information.
- Motion – For every video you can compute motion statistics. Every frame can be given a quantitative number depending on how much motion you perceive in that frame.
- Sound – Based on the wave PCM samples, you could compute audio threshold levels or even frequencies that give allow you to compute a quantitative assessment of how much sound/frequency there is in an audio segment.

Querying your database with a clip

This should be a process that takes a short video/audio clip and queries the semantics generated above. An example invocation might be

MyQuery.exe queryvideo.rgb queryaudio.wav

This should extract similar semantic descriptors for the query video/audio and use it to search/index into the list of descriptors created for all your database videos. The output should be a ranked list of videos that either the same/similar to the query media elements The ranking should convey a degree of similarity – higher the rank, more similar is the video. At end of your search, you should open a user interface to show your results, or you could start your user interface and invoke your query from there. An example interface is shown below in the next subsection.

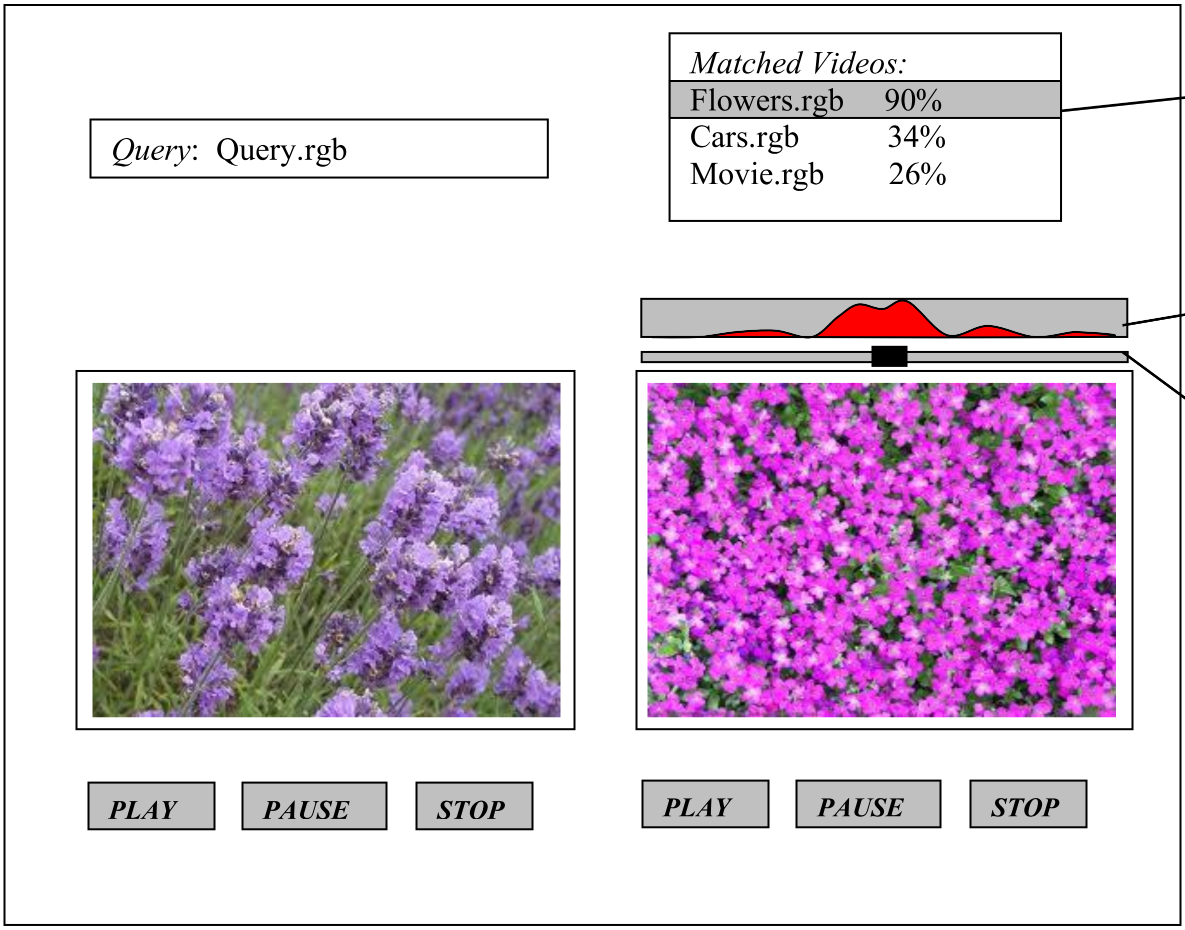
A/V Player and Query Interface

Design a simple interface that shows the short query video clip and a list of matched videos that contain the query clip or similar clips in some ranked order. Here are a few requirements that you need to implement

- You should be able to play, pause and stop the query clip (and its corresponding audio)
- You should be able to show a list of video files that contain the matched query in some ranking order. You should be able to select a video from this ranked list and be able to play, pause and stop the video (and it corresponding audio)

- Additionally, for a selected videos, you should display a visual indicator that shows you where in the video you found a match with the query clip.

An example of such an interface is shown below, you don't need to create the exact same interface, but whatever you create should have the above functionality and allow us to evaluate your result clearly and easily.



Query: Query.rgb

Matched Videos:

Flowers.rgb	90%
Cars.rgb	34%
Movie.rgb	26%

List of matched video with a ranking score. Selected video is loaded for preview

Visual Descriptor showing a matching score

Visual interface for current frame position (could be used for scrubbing)

Expectations and Evaluations:

We do expect that you analyze the problem space and produce a solution. The answers are subjective (when there is no exact match) depending on what parameters and descriptors you extract and how you justifiably use them to compute a quantitative distance measure. Consequently, rather than perceptually making sense, we will be evaluating if your results match according to the descriptors you have extracted. Therefore, it is essential for you to help the evaluation process by showing a visual descriptor that illustrates where your query process found a match. You don't need to create the same interface as shown above, but as long as it helps us evaluate your result – that is fine. When it comes to playing audio and video, we do expect them to be synchronized.