ABSTRACT
This paper aims at presenting the results of LinkedTV’s first participation to the Search and Hyperlinking task at MediaEval challenge 2013. We used textual information, transcripts, subtitles and metadata, and we tested their combination with automatically detected visual concepts. Hence, we submitted various runs to compare diverse approaches and see the improvement when adding visual information.

1. INTRODUCTION
This paper describes the framework used by the LinkedTV team to tackle the problem of Search and Hyperlinking inside a video collection [2]. The applied techniques originate from the LinkedTV project [3], which aims at integrating TV and internet experience, by enabling the user to access additional information and media resources aggregated from diverse sources, thanks to automatic media annotation.

2. PRE-PROCESSING STEP
Concept detection was performed on the key-frames of the video, following the approach in [6], while the algorithm for Optical Character Recognition (OCR) described in [8] was used for text localization. Moreover, for each video, we extracted keywords from the provided subtitles, based on the algorithm presented in [9]. Finally, we grouped the predefined video shots into bigger segments (scenes), based on the visual similarity and the temporal consistency among them, using the method introduced in [7].

3. OUR FRAMEWORK
3.1 Lucene indexing
We indexed all available data in a Lucene index at different granularities: video level, scene level, shot level and segments created using sliding window algorithm [3]. Documents were represented by both textual fields (for a text search) and floating point fields (for the visual concepts).

3.2 From visual cues to detected concepts
Text search is straightforward with Lucene, by using the default text search based on TF-IDF values. In order to incorporate visual information to the search, we mapped keywords extracted from the visual cues query (using Alchemy API) to visual concepts using a semantic word distance based on Wordnet synsets [5]. When visual concepts were detected in the query, we enriched the textual query by range queries on the values of the corresponding visual concepts.

3.3 Search task
We concatenated textual and visual queries to perform the text query. Two strategies were adopted: we either used segments indexed in the Lucene engine, or performed queries creating segments on the fly, by merging video segments based on their score.

Performing a text query on the video index often returned the relevant video in the top of the list. Hence, some runs first restrict the pool of videos that are going to be searched to a small number, and then perform additional queries for smaller segments inside this pool.

We submitted 9 runs in total:
- **scenes-C**: Scene search using textual and visual cues.
- **scenes-noC**: Same as previous using textual cues only (no visual cues) for comparison purposes.
- **part-sc-C**: Partial scenes search from shot boundary using textual and visual cues following three steps: filtering of the list of videos; querying for shots inside each video; ordering them by score. As a shot is a unit that is too small to be returned to a viewer, we completed the segment with the end of the scene that includes this shot.
- **part-sc-noC**: Same as previous using textual cues only.
- **cl10-C**: Temporal clustering of shots within a video using text and visual cues in the following manner: filtering out the set of videos to search; computing scores for every shot in the video; clustering together shots closer than 10 seconds apart (scores were added to form the final score).
- **cl10-noC**: Same as previous using text search only.
- **scenes-S or scenes-U or scenes-I**: Scene search using only textual cue from transcript or subtitle, no metadata.
- **SW-60-I or SW-60-S**: Search over segments created by the sliding window algorithm for LIMSI/Vocapia [4].


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scripts and subtitles, where the size of the sliding windows is 60.

- **SW-40-U**: Same as above for LIUM transcript with sliding window size of 40.

### 3.4 Hyperlinking task

A first approach consisted in reusing the search component with the scene approach and the shot clustering approach. A query was crafted from the anchor: the text query was made by extracting keywords from the subtitles aligned at start time and end time of the anchor. Visual concepts scores were extracted from the keyframes of shots contained in the anchor. If the anchor was constituted by more than one shot, we took for each concept the highest score over all shots.

A second approach made use of MorelikeThisSolr component (MLT) combined with EntitiyClassifier.eu annotation [1]. We created a temporary document from the query as the root for searching similar documents, and performed the search over segments from the LIMSI transcripts created using sliding windows and enriched with synonyms.

### 4. RESULTS

#### 4.1 Search task

The results of the search task are listed in Table 1. We first notice than given the same conditions, subtitles perform significantly better than any of the transcripts, which is an expected outcome. It is also interesting to note that using the visual concepts in the query slightly increases the results for all measures (e.g., clustering10-C vs clustering10-noC).

### 4.2 Hyperlinking task

The results are listed in Table 2. For both LA and LC conditions, runs using scenes outperform other runs for all metrics. The MoreLikeThis/Entityclassifier.eu approach comes second. As expected, using the context increases the precision when hyperlinking video segments. It is also notable that the precision at rank n decreases when n increases.

#### Table 1: Results of the Search task

<table>
<thead>
<tr>
<th>Run</th>
<th>MRR</th>
<th>mGAP</th>
<th>MASP</th>
</tr>
</thead>
<tbody>
<tr>
<td>scenes-C</td>
<td>0.3095</td>
<td>0.1770</td>
<td>0.1914</td>
</tr>
<tr>
<td>scenes-noC</td>
<td>0.3091</td>
<td>0.1767</td>
<td>0.1947</td>
</tr>
<tr>
<td>scenes-S</td>
<td>0.3152</td>
<td>0.1635</td>
<td>0.2021</td>
</tr>
<tr>
<td>scenes-I</td>
<td>0.2613</td>
<td>0.1444</td>
<td>0.1582</td>
</tr>
<tr>
<td>scenes-U</td>
<td>0.2458</td>
<td>0.1344</td>
<td>0.1528</td>
</tr>
<tr>
<td>part-sc-C</td>
<td>0.2284</td>
<td>0.1241</td>
<td>0.1024</td>
</tr>
<tr>
<td>part-sc-noC</td>
<td>0.2281</td>
<td>0.1240</td>
<td>0.1021</td>
</tr>
<tr>
<td>cl10-C</td>
<td>0.2092</td>
<td>0.1525</td>
<td>0.1814</td>
</tr>
<tr>
<td>cl10-noC</td>
<td>0.2849</td>
<td>0.1479</td>
<td>0.1713</td>
</tr>
<tr>
<td>SW-60-S</td>
<td>0.2933</td>
<td>0.1925</td>
<td>0.2027</td>
</tr>
<tr>
<td>SW-60-I</td>
<td>0.1965</td>
<td>0.1206</td>
<td>0.1204</td>
</tr>
<tr>
<td>SW-40-U</td>
<td>0.2368</td>
<td>0.1342</td>
<td>0.1501</td>
</tr>
</tbody>
</table>

Overall, the best approaches are those using scenes and sliding windows. Scene based approaches retrieve a higher number of correct relevant segments within a time window of 60 seconds (higher MRR), but they are not the most precise in terms of start and end time, compared to the sliding windows approach (as suggested by mGAP and MASP).

#### Table 2: Results of the Hyperlinking task

<table>
<thead>
<tr>
<th>Run</th>
<th>MAP</th>
<th>P-5</th>
<th>P-10</th>
<th>P-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA cl10</td>
<td>0.0777</td>
<td>0.4467</td>
<td>0.3200</td>
<td>0.2067</td>
</tr>
<tr>
<td>LA MLT</td>
<td>0.1201</td>
<td>0.4200</td>
<td>0.4200</td>
<td>0.3217</td>
</tr>
<tr>
<td>LA scenes</td>
<td>0.1770</td>
<td>0.6867</td>
<td>0.5867</td>
<td>0.4167</td>
</tr>
<tr>
<td>LC cl10</td>
<td>0.0823</td>
<td>0.5733</td>
<td>0.4833</td>
<td>0.2767</td>
</tr>
<tr>
<td>LC MLT</td>
<td>0.1820</td>
<td>0.5667</td>
<td>0.5667</td>
<td>0.4300</td>
</tr>
<tr>
<td>LC scenes</td>
<td>0.2523</td>
<td>0.8133</td>
<td>0.7300</td>
<td>0.5283</td>
</tr>
</tbody>
</table>

### 5. CONCLUSION

This paper presented our framework and results at the MediaEval Search and Hyperlinking task. From our runs, it is clear that scene segmentation is the approach with the best performances. Therefore, this approach should be studied more in depth, a potential improvement being to refine the segmentation using semantics or speakers information. Also, we see here that this task benefits from the use of visual information present in the video. Hence, those two axes should be the next steps to study for a future challenge.

### 6. ACKNOWLEDGMENTS

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### 7. REFERENCES


