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TRECVID 2017 Hyperlinking task

Eurecom-Polito team

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System overview

- Our system is based on textual and visual feature analysis
  - ❖ The system is multimodal, however it starts with independent monomodal queries and combine the results of these queries to obtain the final result

- We used
  - o Automatic speech recognition (ASR) transcripts
    - o LIMSI
  - o Visual concepts
    - o extracted by using the Caffe framework with the BVLC GoogLeNet model
  - o Metadata
    - o Title, description and tags

- In order to have related text information, we also used:
  - o Named-entity recognition (NER)
    - o Stanford NER (From Stanford university), also known as CRFClassifier
  - o Concept mapping technique
    - ❖ Based on synonymous identified by means of Wordnet

System overview

- The core of all runs is composed of three stages:
  1. **Data segmentation**
     - We considered 120-seconds Fixed-segmentation
       - ❖ We didn't consider overlapping for this year
     - Stop words and punctuation removal tool
     - Word stemming is applied
  2. **Indexing and retrieval**
     - Apache Solr was used to index and retrieve data
  3. **Query formulation and segment retrieval**
     - Transforming the anchor (query) segment into a set of monomodal text-based query
       1. Including in the text of the query:
          - ✓ The words appearing in the LIMSI transcripts, or
          - ✓ The names of the identified visual concepts, or
          - ✓ The words appearing in the metadata
       2. Named-entity recognition and Concept mapping techniques are also applied to increase the importance of entities and the more relevant visual concepts
          - ❖ For increasing the importance, more weight is given to the entity when calculating the relevant score using TF-IDF
     - The prepared query is executed on Solr and returns the most relevant segments

System overview – query types

- LIMSI-based query + Named-entity recognition
  - For each anchor, a textual query is built by considering the words appearing in the LIMSI transcript of the anchor
  - The Name-entity recognition technique is used to identify the words associated with entities
    - A higher weight is assigned to those words in the query
  - The query is executed with respect to the LIMSI transcripts of the queried segments

- Visual concept based query + Concept mapping technique
  - For each anchor, a textual query is built by considering the “names” of the visual concept appearing in the anchor
    - Select only the visual concepts with a score/probability greater than 0.3
  - The Concept mapping technique selects the visual concepts related to the Metadata of the video
    - A higher weight is assigned to those concepts in the query
  - The query is executed with respect to the Visual concepts of the queried segments

System overview – query types

- Metadata based query for segment selection
  - For each anchor, a textual query is built by considering the metadata appearing in the video containing the anchor
    - Metadata are available only at the video level
  - The query is executed with respect to the LIMSI transcripts of the queried segments
    - Segments are returned

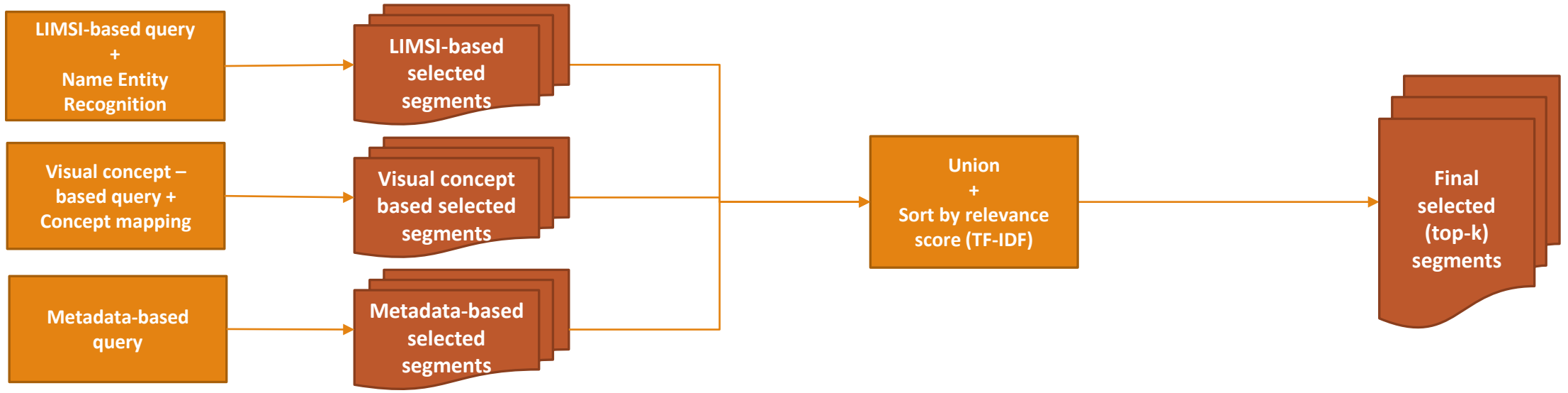
- Metadata based query for video selection
  - For each anchor, a textual query is built by considering the metadata appearing in the video containing the anchor
  - The query is executed with respect to the metadata information the queried videos
    - Videos are returned

SUBMITTED RUNS

1. **Automatic Feature Selection (AFS)**
   - **Features:**
     - ❑ **Metadata, LIMSI, Visual concepts**
       - o **Also Named-entity recognition (NER) and Concept mapping techniques**
2. **Meta-data based approach**
   - **Features:**
     - ❑ **Metadata, LIMSI, Visual concepts**
       - o **Also Named-entity recognition (NER) and Concept mapping techniques**
3. **LIMSI-NER**
   - **Features:**
     - ❑ **LIMSI**
       - o **Also Named-entity recognition (NER)**
4. **Pipeline approach**
   - **Features:**
     - ❑ **LIMSI, Visual concepts**
       - o **Also Named-entity recognition (NER) and Concept mapping techniques**

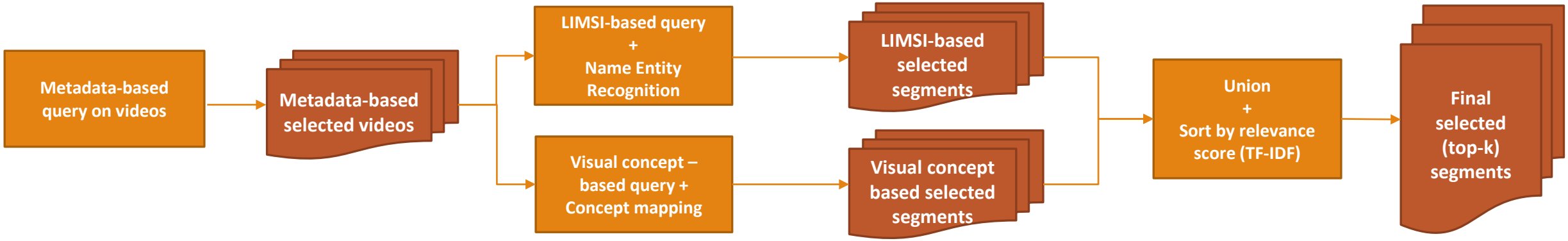
Run 1: Automatic Feature Selection (AFS)

- **Features**:
  - Metadata, LIMSI, Visual concepts
    - ✓ Also Named-entity recognition (NER) and Concept mapping techniques
- **For each anchor:**
  1. Select one set of relevant segments for each feature by considering one feature at a time (monomodal queries)
  2. Consider the union of the segments selected in Step 1, rank them by relevance score, and select the subset of segments with the highest relevance scores
     - We used the TF-IDF-based score returned by Solar to identify the relevance score of each of the selected segments



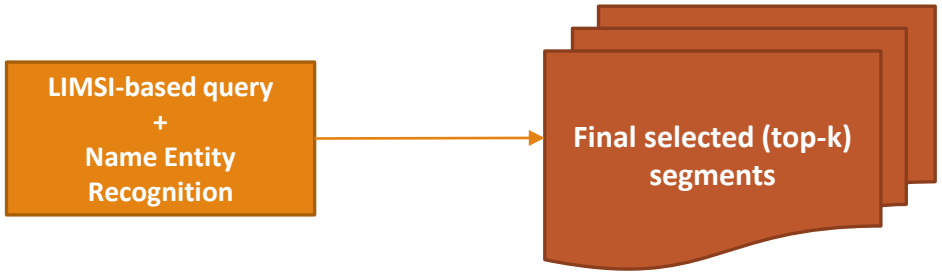
Run 2: Meta-data based approach

- **Features**:
  - Metadata, LIMSI, Visual concepts
    - ✓ Also Named-entity recognition (NER) and Concept mapping techniques
  - Differently from Run 1, Meta-data are used to perform an initial filter on the videos that could contain interesting segments.
- **For each anchor:**
  1. Select relevant videos by using metadata for querying the video collection
  2. Select the most relevant segments from the selected videos by using LIMSI and visual concepts
     - Combine the results of two monomodal queries
     - We used the TF-IDF-based score returned by Solar to identify the relevance score of each of the selected segments



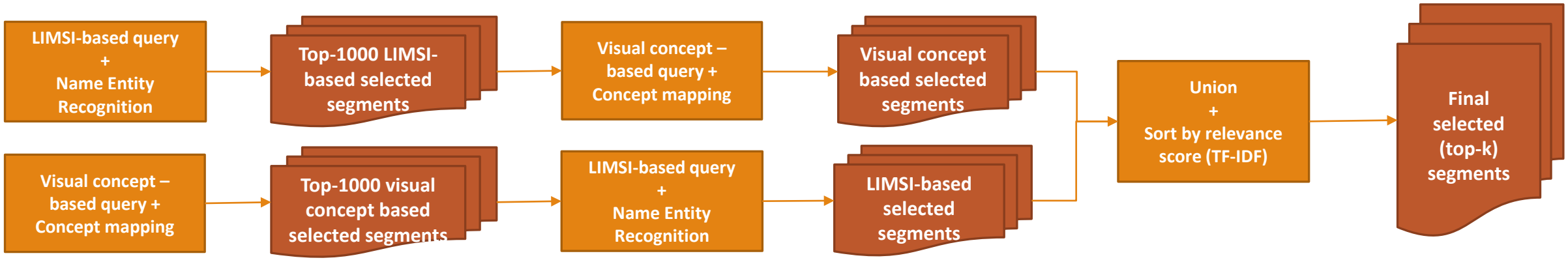
Run 3: LIMSI-NER

- **Features**:
  - LIMSI
    - ✓ Also Named-entity recognition (NER) technique
- **For each anchor:**
  1. Select relevant segments by using LIMS for querying the video collection
     - We used the TF-IDF-based score returned by Solar to identify the relevance score of each of the selected segments
- **Monomodal algorithm**
  - The aim of this algorithm to analyze the differences between monomodal and multimodal approaches
  - The LIMSI transcript feature, on the development anchors, performs better than the other features



Run 4: Pipeline approach

- **Features:**
  - LIMSI, Visual concepts
    - ✓ Also Named-entity recognition (NER) and Concept mapping techniques
- **For each anchor:**
  - **Step 1-1:** Select the top-1000 relevant segments by using LIMSI for querying the video collection
  - **Step 1-2:** Select the most relevant segments from the segments selected in Step 1-1 by using visual concepts
  - **Step 2:** Repeat Step 1 by switching the roles of LIMSI and visual concepts
  - **Step 3:** Consider the union of the segments selected in Step 1, rank them by relevance score, and select the subset of segments with the highest relevance scores



RESULTS

- Run 1 (Automatic Feature Selection) yields the best results in term of all the considered metrics
- Run 2 (the Meta-data based approach) achieved the lowest result
  - The Meta-data-based video pre-filtering step selects very few related videos for some anchors
- The achieved results show that the proper combination of several features performs better than single features

RUN	Name	P @ 5	P @ 10	MAP	MAiSP
1	**Automatic Feature selection (AFS)**	**0.8400**	**0.8080**	**0.1638**	**0.2527**
2	Metadata based approach	0.7040	0.5560	0.0815	0.1320
3	LIMSI-NER	0.7250	0.6667	0.0930	0.1547
4	Pipeline approach	0.8080	0.7480	0.1135	0.1851

RESULTS - Automatic Feature selection (AFS)

- The table below demonstrates:
  1. the total percentage of occurrence for each modality for the top 10 segments
  2. the percentage of average performance per modality over all the queries.

❖ It is completely clear that most of the relevant segments are returned by visual concepts, However, Metadata has a high proportion for the relevant segments

❖ However, based on the average performance per modality:

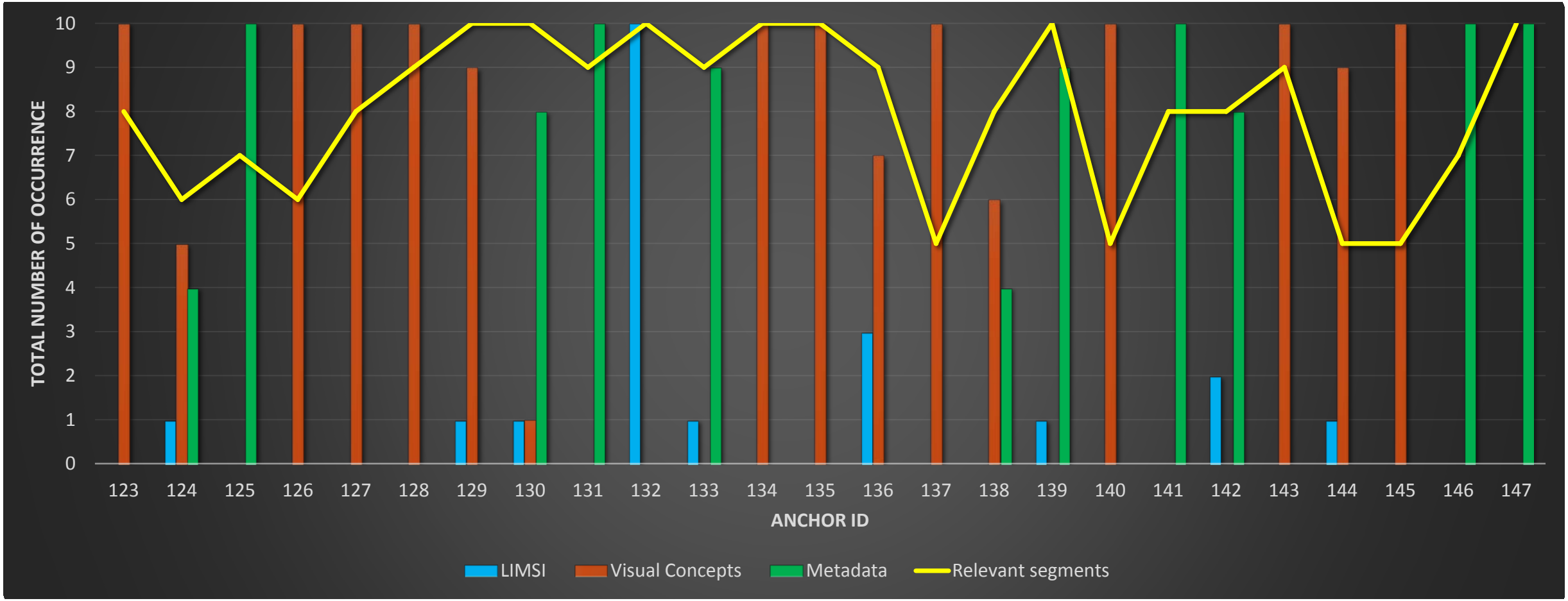
✓ All the modality tested are relevant and accuracy is rather strong.

✓ Using visual concepts only would not win over the multimodal approach.

Feature	% of occurrence in top 10 segments	% average performance per modality over all the queries
LIMSI	8.4 %	76.2 %
Visual concepts	54.8 %	75.2 %
Metadata	36.8 %	89.1 %

RESULTS - Automatic Feature selection (AFS)

- The chart below shows the total number of occurrence of each modality for each anchor and for the 10 segments



FUTURE WORK AND CONCLUSION

- The proposed system has explored the use of textual and visual features for solving the Hyperlinking task.
  - ❖ Specifically, we have considered the LIMSI transcripts, visual concepts and Meta-data.
  - ❖ Moreover, named-entity recognition and a concept mapping technique have also been considered.

- The achieved results show that the proper combination of several features performs better than single features.

- For the future work:
  - ❑ On the AFS approach, features like OCR would be added to the algorithm for further analysis
  - ❑ On the pipeline approach, the intersection of the various modalities (pairs and also the triplet) will be analyzed

Thank you for your attention

Authors are awaiting questions by email

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