Multimedia analysis of video collections: visual exploration of presentation techniques in ted talks

A. WU AND H. QU. MULTIMODAL ANALYSIS OF VIDEO COLLECTIONS: VISUAL EXPLORATION OF PRESENTATION TECHNIQUES IN TED TALKS. IEEE TRANSACTIONS ON VISUALIZATION AND COMPUTER GRAPHICS, 2018.

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INFORMATION VISUALIZATION

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Motivation

What are some features (verbal/non-verbal) of a good presentation?

- Avoid incessant hand movements
- Don't leave hands idle

Problems

- Suggestions are puzzling learners
- Non-verbal presentation techniques has been neglected in large-scale automatic analysis
- Lack of research on the interplay between verbal and non-verbal presentation techniques
- Only limited data-mining techniques for existing research

Proposed Solution

- Quantitative analysis on the actual usage of presentation techniques
- In a collection of good presentations (TED Talks)
- To gain empirical insight into effective presentation delivery

Contributions

- A novel visualization system to analyze multimodal content
- Temporal distribution of presentation techniques and their interplay
- A novel glyph design
- Case study to report the gained insights
- User study to validate usefulness of the visualization system

Challenge

Multimodal content

- Frame images
- Text
- Metadata

User-Centered Design Process

[Fig. 2. A. Wu and H. Qu. Multimodal analysis of video collections: Visual exploration of presentation techniques in ted talks. IEEE Transactions on Visualization and Computer Graphics, 2018.]

Preliminary Stage

Contextualized Interview

- Three domain experts
- Individual interviews to understand main problems
- Problems:
  - Case-based evidence rather than large-scale automatic analysis
  - Manual search to find examples

Preliminary Stage

Focus Group

- Before:
  - 14 Candidates
  - Mentioned in the domain literature
  - Quantifiable by computer algorithms
- After:
  - Three very significant and feasible presentation techniques
  - Rhetorical modes
  - Body postures
  - Gestures

Preliminary Stage

Presentation techniques

1) Rhetorical mode
- Narration
- Exposition
- Argumentation

2) Body Posture
- Close Posture
- Open Arm
- Open Posture

3) Body Gesture
- Stiff
- Expressive
- Jazz

Iteration Stage

- Three rounds
- Paper-based design and code-based prototyping
- Feedback-based enhancement

Analytical Goals

G1: To reveal the temporal distribution of each presentation technique

G2: To inspect the concurrences of verbal and non-verbal presentation techniques

G3: To identify presentation styles reflected by technique usage and compare the patterns

G4: To support guided navigation and rapid playback of video content

G5: To facilitate searching in video collections

G6: To examine presentation techniques from different perspectives and provide faceted search

Visualization Tasks

T1: To present temporal proportion and distribution of data

T2: To find temporal concurrences among multimodal data

T3: To support cluster analysis and inter-cluster comparison

T4: To compare videos at intra-cluster level

T5: To enable rapid video browsing guided by multiple cues

T6: To allow faceted search to identify examples and similar videos in video collections

T7: To display data at different levels of detail and support user interactions

T8: To support selecting interesting data or feature space

T9: To algorithmically extract meaningful patterns and suppress irrelevant details

System Architecture

- **Data Processing**

  Collect TED talks and extract presentation techniques

- **Visualization**

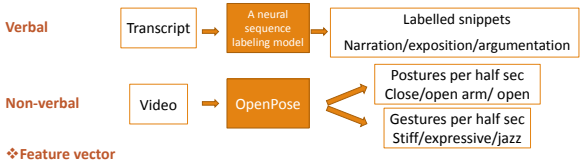
  Interactive visual analytic environment for deriving insights

[Fig. 3. A. Wu and H. Qu. Multimodal analysis of video collections: Visual exploration of presentation techniques in ted talks. IEEE Transactions on Visualization and Computer Graphics, 2018.]

Data Processing

- **Data**
  - 146 TED talks gathered from the official website in the chronological order
  - Videos
  - Transcript (segmented into snippets with various time intervals)
  - Metadata
- **Data processing techniques**
  - Verbal
  - Non-verbal

Data Processing (cont.)



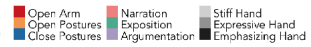
❖**Feature vector**
- 9x1 vector
- Temporal proportion of each of the nine techniques

Visual Design

[Fig. 5. A. Wu and H. Qu. Multimodal analysis of video collections: Visual exploration of presentation techniques in ted talks. IEEE Transactions on Visualization and Computer Graphics, 2018.]

Unified Color Theme

- Posture: Cool color for close posture
- Gesture: higher saturation for larger movement
- Rhetorical mode: Color psychology
  - Narration: Pink (Symbolizing life)
  - Exposition: Green (Reliability)
  - Argumentation: Purple (Wisdom)



[Part of Fig. 7. A. Wu and H. Qu. Multimodal analysis of video collections: Visual exploration of presentation techniques in ted talks. IEEE Transactions on Visualization and Computer Graphics, 2018.]

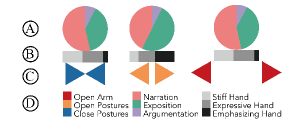
TED talk glyph

Metaphor of the human body

Head: Pie-chart, proportion of rhetorical modes

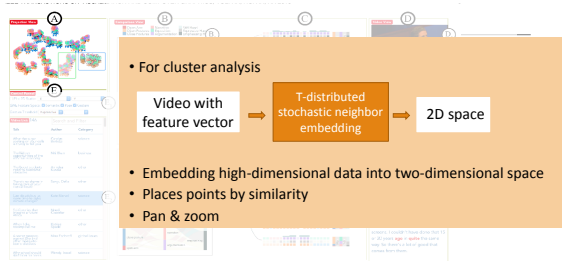
Shoulders: Bar-chart, percentage of gestures

Triangles: Frequent hand posture



[Fig. 7. A. Wu and H. Qu. Multimodal analysis of video collections: Visual exploration of presentation techniques in ted talks. IEEE Transactions on Visualization and Computer Graphics, 2018.]

Projection View

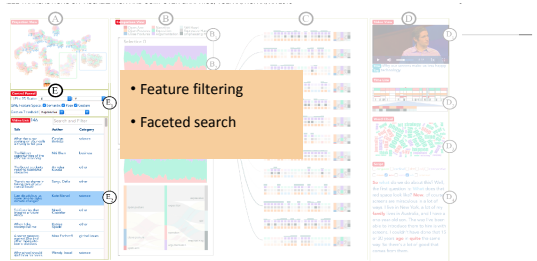


- For cluster analysis

Video with feature vector → T-distributed stochastic neighbor embedding → 2D space

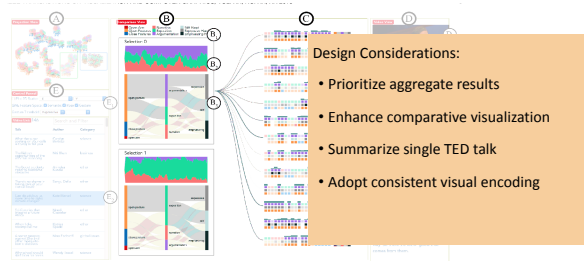
- Embedding high-dimensional data into two-dimensional space
- Places points by similarity
- Pan & zoom

Control Panel



- Feature filtering
- Faceted search

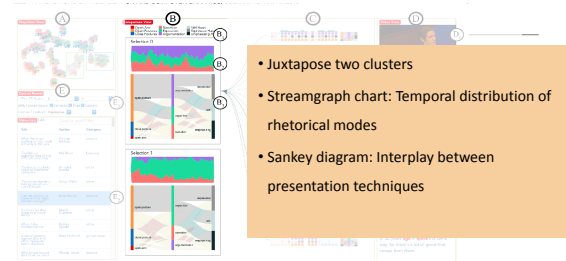
Comparison View



Design Considerations:

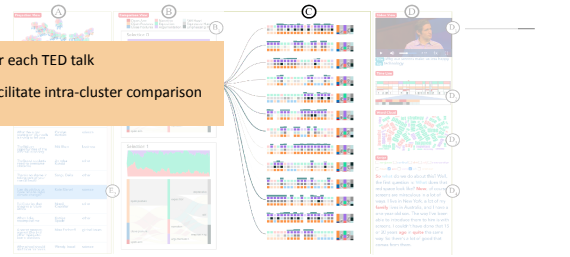
- Prioritize aggregate results
- Enhance comparative visualization
- Summarize single TED talk
- Adopt consistent visual encoding

Comparison View -> Aggregate View



- Juxtapose two clusters
- Streamgraph chart: Temporal distribution of rhetorical modes
- Sankey diagram: Interplay between presentation techniques

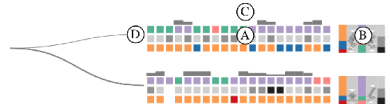
Comparison View -> Presentation Fingerprinting



- For each TED talk
- Facilitate intra-cluster comparison

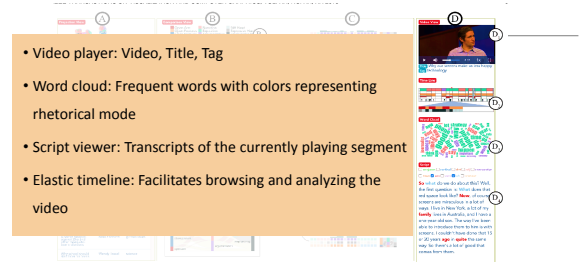
Comparison View -> Presentation Fingerprinting(cont.)

- Rows (top to bottom): Rhetorical mode, Gesture, Posture
- Uniform time interval of 5% of the talk duration
- Embedded bar-chart: Top concurrence tuples



[Fig. 9. A. Wu and H. Qu. Multimodal analysis of video collections: Visual exploration of presentation techniques in ted talks. IEEE Transactions on Visualization and Computer Graphics, 2018.]

Comparison View -> Video View



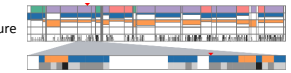
- Video player: Video, Title, Tag
- Word cloud: Frequent words with colors representing rhetorical mode
- Script viewer: Transcripts of the currently playing segment
- Elastic timeline: Facilitates browsing and analyzing the video

Elastic Timeline

- Two layers
- First layer: Timeline is segmented according to the transcript snippet
- Usage of presentation techniques arranged vertically
- Row 1: Rhetorical mode
- Row 2-4: Three types of body posture
- Bar-charts: The proportion of corresponding posture during the time interval
- Row 5: Bar-chart represents body gesture

Unfold the bottom layer

- Gestures and postures during the selected segment
- Each grid show a half second
- Blank grid: Any information is non-retrievable



[Fig. 10. A. Wu and H. Qu. Multimodal analysis of video collections: Visual exploration of presentation techniques in ted talks. IEEE Transactions on Visualization and Computer Graphics, 2018.]

Evaluation -> Case Study

- With 3 experts and 3 students
- To reflect the fulfillment of analytical goals and gain insight
- Used the system and provided feedback

- Results:
  - System reached the analytical goals
  - Findings matched the theories
  - Incorporate the system into theirs current research and teaching practices
  - Suggested more gestures such as pointing

Evaluation -> User Study

- With 16 students
- To demonstrate the capacity of undertaking visualization tasks and gather feedback
- Went through a series of tasks and provided feedback

- Results:
  - All participants understood and completed tasks
  - They agreed system is usable for video collections
  - Less satisfied with video comparison view

Limitations and Future Work

LIMITATIONS

- Research Scope
- Accuracy
- Presentation Fingerprinting
- Overlapping among glyphs
- Comparison of two clusters

FUTURE WORK

- Extract additional features
- Improve accuracy
- Assist more analytical tasks
- Evaluate with other presentation scenarios

Analysis Summary

- What (data):
  - Video (image frames)
  - Text (transcripts)
  - Metadata (tags)
- What (derived):
  - Tags for postures per half sec/gestures per half sec/rhetorical mode per snippet
  - Feature vector (temporal proportion of nine techniques)
- Why (tasks):
  - T1-T9

Analysis Summary (cont.)

- How (encode):
  - 2D plot
  - Bar-chart
  - TED talk glyph (using pie-chart, bar-chart, distance and direction of triangles)
  - Streamgraph
  - Sankey diagram
  - Links (relation between each talk and aggregated data)
  - Table (each talk)
  - Grid (timeline)
  - Stacked bar-chart (postures in timeline)
  - Consistent color-map(hue/saturation)
- How (Reduce):
  - Filtering of features
  - Aggregation

Analysis Summary (cont.)

- How (Facet):
  - Partition into multiform views
  - Juxtapose views for comparison
  - Linked highlighting
  - Linked navigation
  - overview–detail with selection in overview populating detail view
- How (Manipulate):
  - Select (clusters, control panel & video view)
  - Collapse and expand
  - Zoom & pan (projection view)

Critique

STRENGTHS

- Carefully designed with well justified design choices
- Sophisticated view coordination (screen-space effective & different levels of details)
- Consistency in visual mappings
- Reduce cognitive/memory burden
- Carefully designed glyph
- Inter-, Intra-cluster & within-video analysis

WEAKNESSES

- Why TED talks / Which TED talks
- Evaluated only on a small set of TED talks
- Some parts are not related to any of the tasks (word cloud)
- Does not discuss the ability of the system to scale when number of features or videos or the duration of videos increases
- Only captures simple relationships among presentation techniques
- Unnecessary encodings / details without explanation (elastic timeline)