

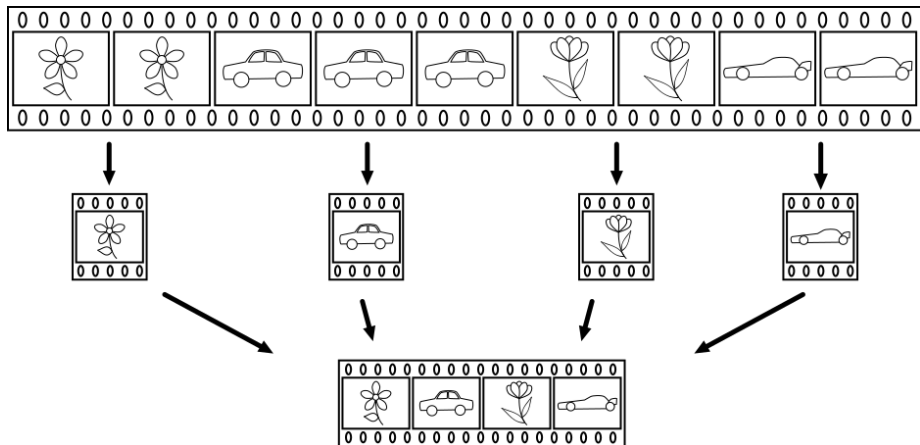
An Approach to Personalized Video Summarization Based on User Preferences Analysis

Maria Miniakhmetova, Mikhail Zymbler
miniakhmetovams@susu.ru, mzym@susu.ru

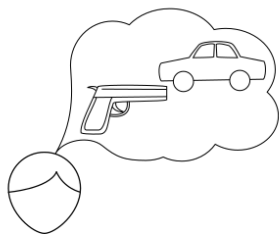
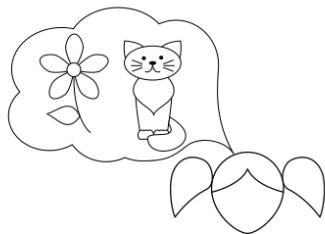
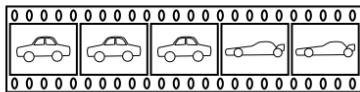
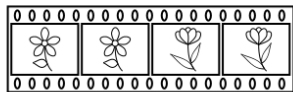
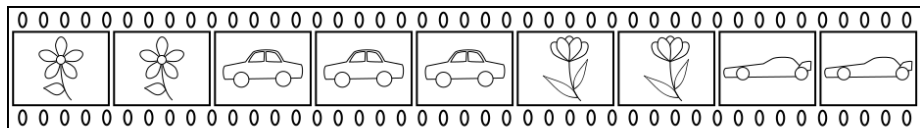
South Ural State University, Chelyabinsk, Russia

9th International Conference on Application of Information
and Communication Technologies

Video Summarization

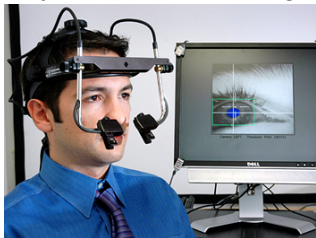


Personalized Video Summary

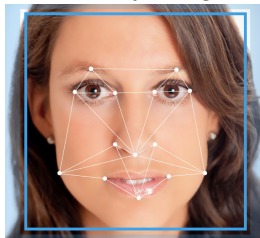


Using Extra Devices

Eye movements tracking



Facial activity recognition



Analyzing physiological responses



Using data from personal cameras

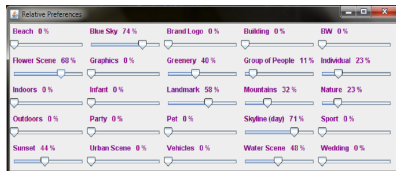


Without Extra Devices

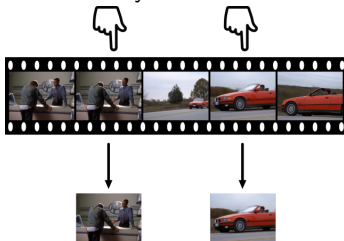
Analyzing text description

A screenshot of a Twitter feed. The tweets are about Fashion Week and a video. The video player shows a woman being interviewed. The text of the tweets includes: "Allora... @sara... Backstage.com@Sara - Madness at Fashion Week. This is what MODCLO face on the runway!", "Bladivem... New York Fashion Week: Project Runway spring/summer 2011 - http://www.projectrunway.com/PR116", "FendiFlash... Fashion happy fashion week NYC. Make sure u get to the Chanel & man: jacque show and catch @chanelny on the runways!", "Beauty@swellpt... I uploaded a YouTube video -- Backstage New York Fashion Week Interview with Ted Gibson... http://youtu.be/YsKkfvgPvXE?u", "LilyMaklan... We made a video some favorite on YouTube -- NY Fashion Week: First Day Highlights: http://youtu.be/UM8kz6g", "Gadner@katch... @Dorothy1014 you did! love fashion week?", "JPharrance... New York fashion week! pizz", "Dik_Mitch... Off to fashion week new york a full CD", "User@delmi... I honestly don't really care for Fashion Week. There's a surpris".

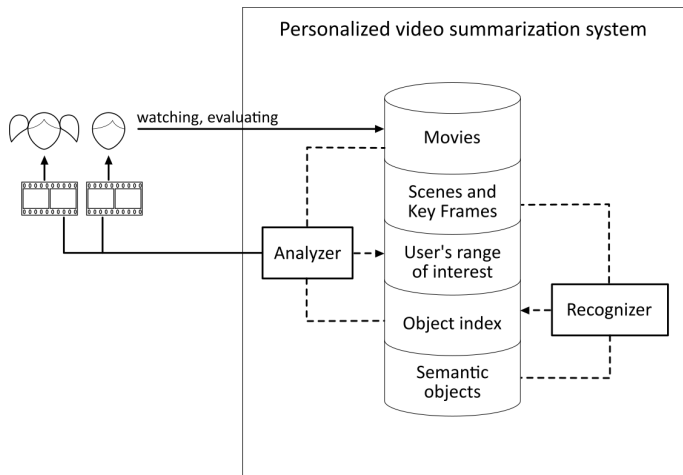
Specifying preferences manually



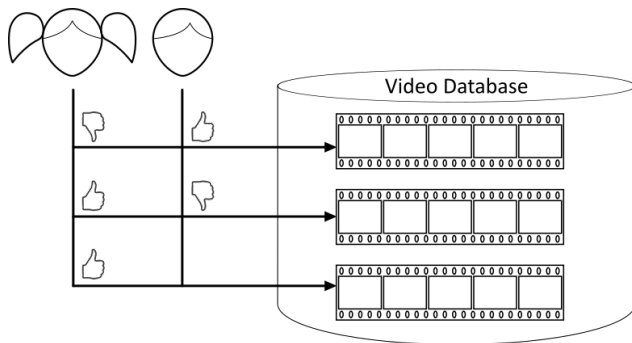
Manual key frames selection



Approach Proposed in This Work



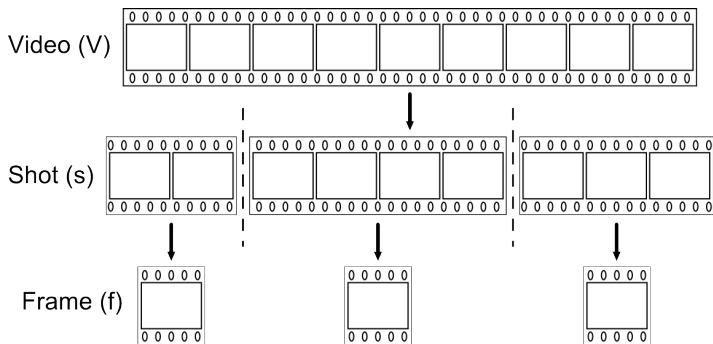
User's Evaluations



Formal definition

$$E = \{e^+, e^0, e^-\}$$

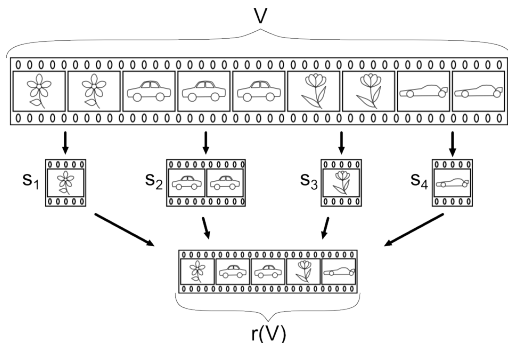
Video Structuring



Formal definition

$$V = \{s_i\}_{i=1}^n; 0 < n \leq F$$

Video Summary

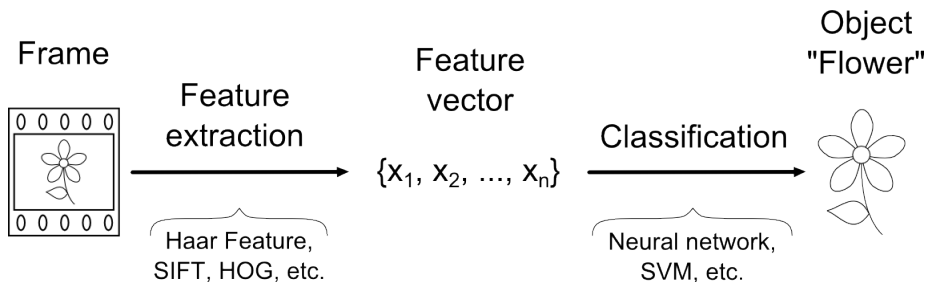


Formal definition

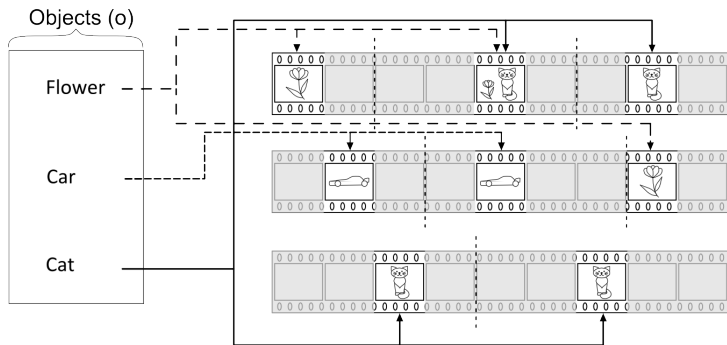
$$r(V) = \{s_j\}_{j=1}^t; s_j \subseteq V$$

$$d(r(V)) = \sum_{j=1}^t d(s_j) \leq d_{max}$$

Object Detection



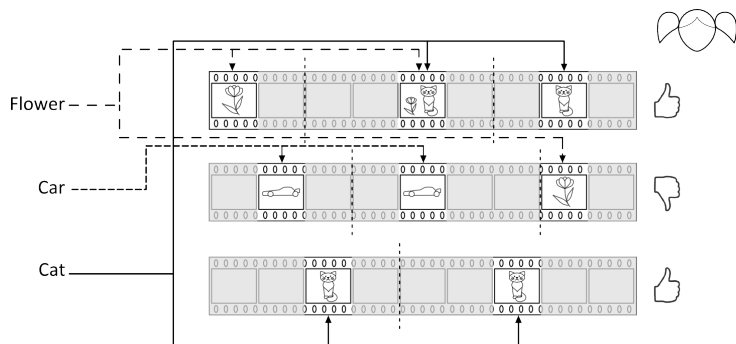
Object Indexing



Formal definition

$$O = \{o_i\}_{i=1}^M$$

Importance of Objects

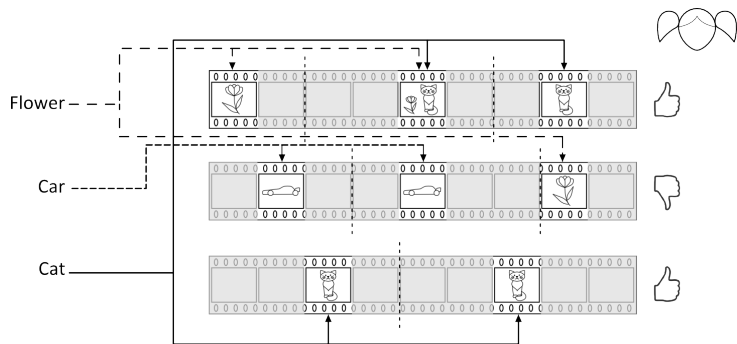


Formal definition

$$P(A_i) = P(A_i|e^+) \cdot P(e^+) + P(A_i|e^0) \cdot P(e^0) + P(A_i|e^-) \cdot P(e^-)$$

$$P(A_i) = P(A_i \cap e^+) + P(A_i \cap e^0) + P(A_i \cap e^-)$$

Importance of Objects

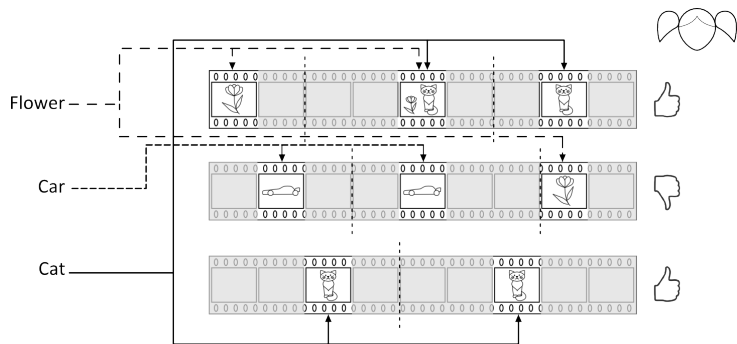


Formal definition

$$P(A_i|e^+) = \frac{L_i}{L}; \quad P(A_i|e^0) = \frac{N_i}{N}; \quad P(A_i|e^-) = \frac{D_i}{D}$$

$$P(e^+) = \frac{L}{W}; \quad P(e^0) = \frac{N}{W}; \quad P(e^-) = \frac{D}{W}$$

Importance of Objects



Formal definition

$$Imp(o_i) = func(P(A_i), L_i, D_i, N_i)$$

Impact of shots

Importance of object $Imp(o_i)$

$$Imp(o_i) = P(A_i) \cdot \frac{L_i - D_i}{\max(1, N_i)}$$

Impact of shot

$$Imp(s_j) = \operatorname{sgn}\left(\operatorname{argmax}_{o_i \in s_j} (|Imp(o_i)|)\right) \cdot \max_{o_i \in s_j} |Imp(o_i)| \cdot \sum_{o_i \in s_j} |Imp(o_i)|$$

Personalized Video Summary

Formal definition

$$pr(V) = \bigcup_{i=1}^t s_i | s_i \subseteq V;$$

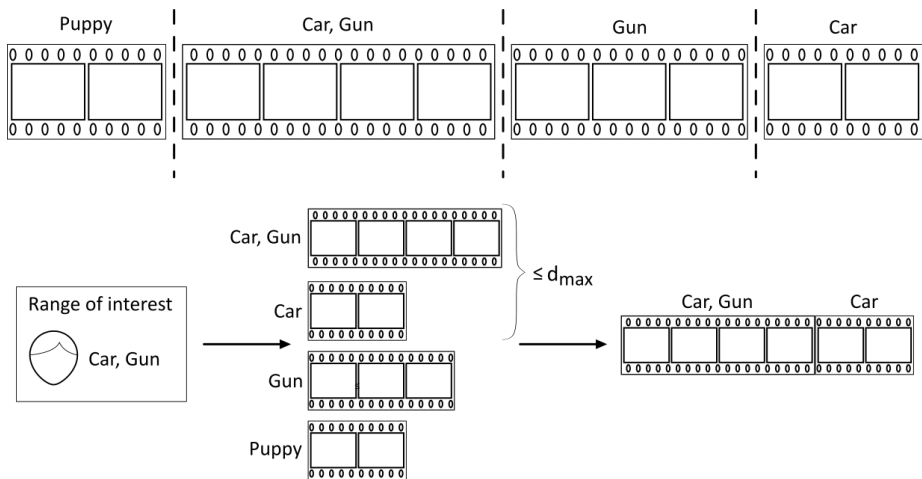
$$\sum_{i=1}^t d(s_i) \leq d_{max};$$

$$\forall s_i \subseteq pr(V), s_j \not\subseteq pr(V) : |Imp(s_i)| \geq |Imp(s_j)|$$

Algorithm of Summary Construction

- 1 Detect shots on video files stored in database.
- 2 Detect objects O on shots of the video files stored in database.
- 3 Calculate importance $Imp(o_i)$ of each object for the particular user.
- 4 Calculate the impact $Imp(s_j)$ of each shot of the video file that hasn't been watched by the user yet.
- 5 Rank shots of the video file on the basis of the absolute values of their's impact.
- 6 Select top t shots, the total duration of which doesn't exceed the predefined threshold value d_{max} .
- 7 Join all of the selected shots to construct personalized video summary $pr(V)$.

Summary Construction



Evaluation of the Personalized Video Summary

Forecast evaluation of the original video file

$$Imp(V) = func(Imp(s_j))$$

Variants of the function

1

$$Imp(V) = sgn\left(\sum_{s_j \in V} Imp(s_j)\right)$$

2

$$Imp(V) = sgn\left(\sum_{s_j \in V} Imp(s_j) \cdot \frac{d(s_j)}{d(V)}\right)$$

Evaluation of the Personalized Video Summary

Actual evaluation of the original video file

$$E = \{e^+, e^0, e^-\}$$

Adequacy of the constructed video summary

$$Ad(pr(V)) = \begin{cases} 1, (E = Imp(V)) \\ -1, (E \neq Imp(V)) \end{cases}$$

Future Work

