Visual Memes in Social Media
Tracking real-world news on YouTube

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The problem

- Information diffusion on YouTube
  - Can we track the video-equivalent of “RT”, “@” ... ?

- Understanding real-world events
  - Can studying YouTube tell us what content are interesting, and who are important?
Outline

- Events on YouTube
- Quoting and remixing with videos
- Visual Meme detection
- Observations, influence and importance
Event buzz on YouTube

- YouTube: too much content?
  - 48 hrs uploaded every minute, >=10% of internet traffic
- How are real-world events reflected on YouTube?

Pop quiz:
which trace is about swine flu? earthquake?

Event buzz on YouTube

- Event Buzz: noisy activity trace left by real-world events

1. Bhutto assassination
2. Cricket bombing + protest
3. Post-election protests
4. Friday Prayer in Tehran
5. H1N1 Human trial begin
6. Haiti earthquake
7. Chili earthquake
8. California earthquake
Monitoring event buzz on YouTube

query definition

targeted querying

media + metadata

Remove-duplicates
Video shot segmentation
Visual feature extraction
Shallow text processing...

pakistan military
pakistan india tension
pakistan taliban
pakistan bhutto
pakistan ppp
pakistan terrorist

downloaded Apr-Aug 2009
Who is Reporting Events on YouTube?

Content authored or remixed by:
• Professional news agencies: AssociatedPress, AlJazeeraEnglish, BBCWorldwide, PakistanHerald, ...
• News enthusiasts: mqmloveyou, askersamet55, tmny2008, ...
• General users (1000+)
What is YouTube?

- Is it
  - A media outlet?
  - A place to look at pointless monologues, babies and dogs?
- YouTube is
  - Is a “platform for participatory culture”
  - It is “ruled by the clip and the quote” – remixing is popular!

[Burgess and Green 2009]
[Snickars and Vonderau 2010]
Remixing on Youtube

Video A

Youtube Video page

Video B

Meme shot examples
Visual memes

- Meme := a cultural unit (an idea or value or pattern of behavior) that is passed from one person to another by social means.
- Visual meme := frequently re-posted visual units -- image or short video segments.

upload: 2009-06-21
author: shobeir1976
title: Ey Shahid (O Martyr)

51 other videos, 2009-06 ~ 08
How to detect visual memes?

- Nearest neighbor search?

- Challenges:
  - Appearance variations: size, quality, color, gamma, overlay, borders ...
  - Do this for 1 Million images, potentially $O(N^2)$
Visual meme detection

- Video keyframes
- Meme clusters
- Non-memes
- Matched pairs

1. Robust feature extraction
2. Build FLANN Index
3. Approximate NN Lookup
4. Distance Verification
5. Transitive Closure
6. Candidate NN list
7. FLANN tree
8. Color-correlogram feature
Pilot datasets

- Continuously collected from YouTube over 3-9 months time.

<table>
<thead>
<tr>
<th>ID</th>
<th>Topic</th>
<th>Videos</th>
<th>Authors</th>
<th>Shots</th>
<th>Upload time</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Swine flu</td>
<td>31,488</td>
<td>10,804</td>
<td>1,202,479</td>
<td>04/09~03/10</td>
</tr>
<tr>
<td>B</td>
<td>Iran</td>
<td>23,049</td>
<td>4,681</td>
<td>1,255,062</td>
<td>08/07~08/09</td>
</tr>
<tr>
<td>B1</td>
<td>Iran 06/09</td>
<td>5,429</td>
<td>2,393</td>
<td>210,259</td>
<td>09/07~07/09</td>
</tr>
<tr>
<td>C</td>
<td>Housing</td>
<td>2,446</td>
<td>654</td>
<td>71,872</td>
<td>08/07~08/09</td>
</tr>
</tbody>
</table>
Visual meme detection

- $1.2 \times 10^6$ comparisons in $\sim 5$-$7$ hours
- Precision $>96$
  - "housing" data set
  - $\sim 15K$ positive pairs
  - $\sim 25K$ negative pairs

![Precision-Recall Curve](image)

- $P=0.997$, $R=0.735$
- $F1=0.88$
- $P=0.982$, $R=0.801$
- Chosen operating point: $P=0.968$, $R=0.807$
How prevalent are visual memes?

- >50% video contain memes, ~70% authors participate in producing and disseminating memes.
- Video popularity (viewcount) can be inversely correlated with being meme-videos!
Timeline of a visual meme cluster

![Timeline and video volume chart]

- Video volume peaks on June 19, 2005, with a significant drop by July 17, 2005.
- The chart shows a decline in video volume from June 12, 2005, to August 7, 2005.
Meme graphs

- Memes as links

Video graph

\[ G = \{ \mathcal{D}, \mathcal{E}_G \} \]

\[
\begin{align*}
\omega^*_i & \propto v_{ij} \\
\omega'_i & \propto v_{ij} \Delta t^*_j
\end{align*}
\]

Author graph

\[ H = \{ \mathcal{A}, \mathcal{E}_H \} \]

\[
\tau_{rs} = \sum \sum_{\{i, a(d_i) = a_r\}}^{\{j, a(d_j) = a_s\}} \omega_{ij}
\]

\[ r, s \in \mathcal{A}, \quad i, j \in \mathcal{D} \]
Meme graphs

Video graph $G = \{\mathcal{D}, \mathcal{E}_G\}$

$\omega^*_{ij} \propto \nu_{ij}$

$\omega'_{ij} \propto \nu_{ij} \Delta t_{ji}$

Author graph $H = \{\mathcal{A}, \mathcal{E}_H\}$

$\tau_{rs} = \sum_{\{i, a(d_i) = a_r\}} \sum_{\{j, a(d_j) = a_s\}} \omega_{ij}$

$r, s \in \mathcal{A}, \ i, j \in \mathcal{D}$

video ‘J8wjwLcrJAA’
upload date 2009-06-28

author “Shapulak”
Diffusion influence index

- Defined for video $i$ and author $r$

\[
\chi_i = \sum w_v \frac{\zeta_{i,v}}{1 + \zeta_{i,v}}
\]

\[
\chi_r = \sum \{i,a(d_i)=a_r\} \chi_i
\]

Social network

Diffusion cascade

Opinion leader?

Follower, summarizer?
Diffusion influence of authors

**Topic: Iran3**
- Total diffusion influence
  - Maven
  - Citizen buzz leaders
  - Traditional news media

**Topic: SwineFlu**
- Total diffusion influence
  - Russia Today
  - Associated Press
  - CBS News Online

**Normalized diffusion influence**
- Maven
- Traditional news media
- Citizen buzz leaders

**Number of posted videos**
- 1
- 10
- 100

**Australian National University**
Can we predict virality?

- On YouTube: early view-count correlate well with ultimate view count.
  [Szabo and Huberman, CACM2010]

- What should be the dimensions of meme virality?
  - **Volume**: how many people remix with this visual meme?
  - **Longevity**: when is the last remix (among the observed)?
Predicting importance with meme features

- Content volume up to 24 hours
- Author graph centrality features
  - Degree centrality
  - Betweenness centrality
  - Closeness centrality
- Author influence index
- The Mean±Std of the above features over all authors in the first 24 hours
Our Results: Predicting Meme Importance

Evaluation:

- Make binary prediction tasks by thresholding meme volume and longevity at various levels
- Train on first month of the Iran3 topic
- Predict on the next two months
- Using SVM (RBF and D=3)
Related work

- MemeTracker and the dynamics of news cycle [Leskovec et al KDD’09]
- Web-scale image clustering [Liu and Rosenberg, 2007]
- Internet Image Archeology [Kennedy and Chang, MM’08]

Our contribution is to reliably extract and analyze “quoting” on Youtube -- visual memes for understanding video sharing behavior and information dissemination on social video sites.
Summary

- YouTube is a living lab of large-scale social behavior
- We propose visual memes as a tool to track large-scale remixing and quoting in videos
- We observed event dynamics and user influence on real-world news events


- This study is a start: more exciting questions ahead
  - Tracking other video genres and domains
  - Does shot sequences matter?
  - Is the associated text useful?
  - How can we use this?
  - ...


Thank You!

- For listening 😊

Questions welcome

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