Automatic Structuring and Augmentation of a LifeLog of Images

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Outline

• 1 Introduction
  – 1.1 Centre for Digital Video Processing
  – 1.2 Microsoft SenseCam
  – 1.3 Challenges

• 2 Work completed
  – 2.1 Event Segmentation
  – 2.2 Finding Similar Events
  – 2.3 Event Importance

• 3 System Demo

• 4 Planned Work
  – 4.1 Event Augmentation
1.1 Centre for Digital Video Processing

• Headed by Prof. Alan F. Smeaton

• 45 full-time researchers

• Focus on multimedia information retrieval

• Starting to look into area of lifelogging
1.2 Lifelogging device of our group

Microsoft SenseCam

- Captures approx. 3,000 pictures/day
- Captures sensor data (light, movement, temperature, passive infra red)
1.3 How to review all these images?

- Playing a movie of one’s day takes too long to review
1.3 What we would like to do – event segmentation

A day’s SenseCam images
(2,000 – 3,000)

Event Segmentation

Multiple Events

- Finishing work in the lab
- At the bus stop
- Chatting at Skylon Hotel lobby
- Moving to a room
- Tea time
- On the way back home
1.3 What we would like to do – finding similar events

- When was the last time I was doing something similar to this event of talking to my friend?
1.3 What we would like to do – most important events

- Talking to the president of the USA would be more memorable than breakfast last Tuesday morning.

- We argue that activities that only occur sporadically (talking to George Bush) are more important than those that occur frequently (having breakfast), i.e. they’re more unique – novelty detection.
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2.1 Event segmentation – sample activities

Breakfast

Work

Car

Talking to colleague

Airplane

Talking to friend

Aiden Roger Doherty, CDVP
2.1 Event segmentation

We segment images based on:

- Low-level image features
- Temperature sensor
- Light level sensor
- Accelerometer sensor
2.1 Image processing

One Day's Images

For each image...

Extract MPEG-7 descriptors...

- Scalable Colour
- Colour Structure
- Colour Layout
- Edge Histogram

... to compare Similarity between...

... adjacent images

... adjacent blocks of 10 images

Event-segmented images of a day
2.1 Sensor processing

- All sources normalised and fused
In this paper we segment images based on:

- Low-level image features
- Temperature sensor
- Light level sensor
- Accelerometer sensor
- Audio features

AIM: To investigate the optimal combination of the aforementioned data sources for activity/event segmentation
2.1 Evaluation Approach

- Judge unique boundaries from each approach

- 22,173 images over 10 day period. 130 hours images, 70 hours audio
2.1 Results – individual sources

The graph shows the results for individual sources, with categories for Image, Temp, Light, Acc, and Audio. The green bars represent True Positive results, while the gray bars represent False Positive results. The vertical axis represents the number of results ranging from 0 to 50.
2.1 Examples of event change types

- Location changes

- Changes within the same location

- Changes due to social interaction
2.1 Results – individual sources

![Graph showing results for individual sources]

- **Image**
- **Temp**
- **Light**
- **Acc**
- **Audio**

**Legend:**
- **Location Change**
- **Within Location**
- **Social**
- **False Positive**

**Change Type**
- **Best Source**
  - Location: Accelerometer
  - Within Location: Image or Light
  - Social: Audio or Img/Lig
2.1 Results – final system selection

- **Audio and accelerometer**: audio for social interaction, acc for location

- **Image, light, and acc**: Image & light for within location and social, acc for location

- **All 5 sources combined**
Event segmentation - results

- Combination of Image/Light/Accelerometer did best
- Produced lowest percentage of false positives and also produced largest number of unique segmentation results
- Reduced processing load, can do away with 2 sources
2.2 Event representation

Multiple Events

- Currently to represent each event, all of the images within that event are averaged.
- It will be necessary to investigate weighting the images, with those in the middle of an event likely to be more representative of that event, than images near the start and end of the event.

- Currently we represent events using low-level image descriptors only.
- It will be necessary to utilise contextual information to represent an event, e.g. location, temperature, motion, light levels.
2.2 Finding similar events

- To find events that are similar to a reference event, it will be necessary to compare all events against that reference event.

- There is the research challenge of determining the optimum similarity threshold i.e. how sufficiently similar must the resultant events be?
2.3 Event uniqueness

- Currently I find the most dissimilar event of today by taking the previous 6 days into account.

- What is the optimal number of previous days to consider?

- Is it better to consider the previous 6 Wednesdays as opposed to the previous 6 days?

- Optimal image to choose as event keyframe
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4.1 Event augmentation

Here’s an image from my SenseCam after a big match in Croke Park. I’d really like to see other people’s pictures of this match.

Let’s search by location...
4.1 Event augmentation

These results (based on location) are not what I wanted.

In addition I’ll search by images taken at approximately same time the match was played...
4.1 Event augmentation

Excellent! These pictures are of the match I was at!
4.1 Event augmentation

Here’s a SenseCam picture of a building that I like from the pier in Santa Barbara, CA.

Again I search for other pictures in the same location…
4.1 Event augmentation

Searching by time will not be that helpful as there was no specific event occurring at the time I was there.

Therefore let’s try filtering the results to only include those that are visually most similar to the reference SenseCam image…
4.1 Event augmentation

These results are much better!
Thank You

further information:

http://www.cdvp.dcu.ie/SenseCam