Expression Snippets: A Robust Method for Dynamic Facial Expression Recognition

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1. Introduction

Since facial expression reflects the person's mind directly, automatic facial expression recognition has been applied in many fields, such as distance education, clinical research, computer game.

- Most of the current work uses all frames in a sequence for recognition part.
- Humans are able to identify the expression by only several frames instead of the whole sequence.
- Our research focuses on selecting the most representative keyframes for facial expression recognition.

2. The aims of the project:

- Identifying representative keyframes with the keypoint trajectory.
- Developing new features based on the keypoint trajectory.

3. Methodologies:

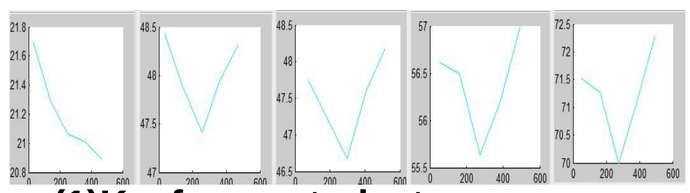
Expression Snippets:

- We get expression snippets from each whole facial expression sequence. Instead of concentrating on one frame from each sequence, we pay more attention to the relationships between frames so that motion trend information could be captured.
- The steps for getting expression snippets:
- Using SIFT descriptor to get keypoints in each frame.
- Matching each two frames' keypoints to get trajectory curves.
- Using curve simplification algorithm to simplify curves.
- Find keyframes according to the rest keypoints from simplified curves.

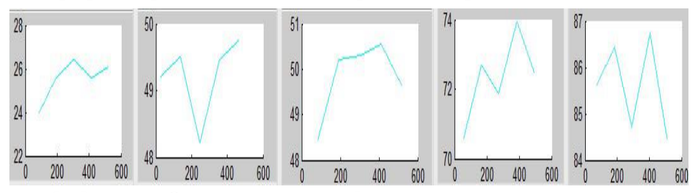
Extracting new features

- After getting expression snippets , we track keypoints again to get trajectory curves. The figures below show each trajectory curve in each frame by using expression snippets from two different image sequences with the same expression. We could find curves have some potential features. Therefore, we use gradient vectors as the trajectory descriptor (t stands for the frame).

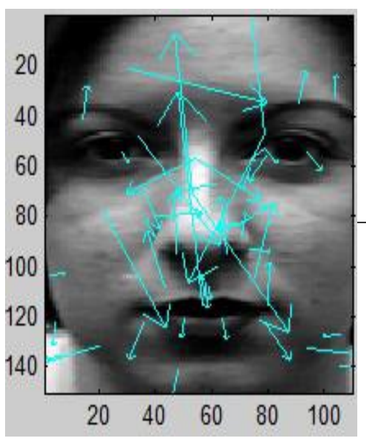
The gradient: $\Delta Gt=(xt+1 - xt)/(yt+1 - yt)$.
Trajectory descriptor:$(\Delta G1, \Delta G2,\ldots, \Delta GL-1)$



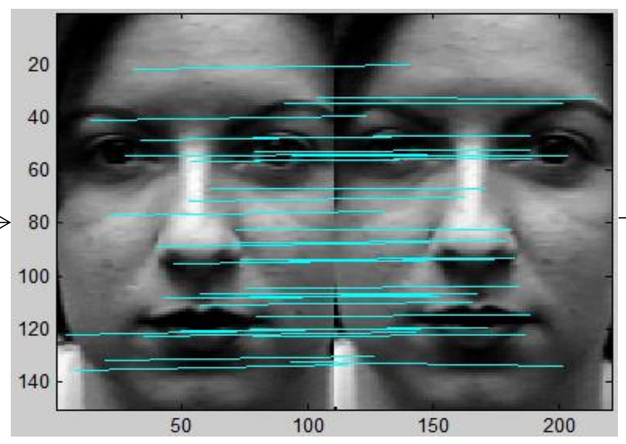
(1)Keyframes trajectory curves



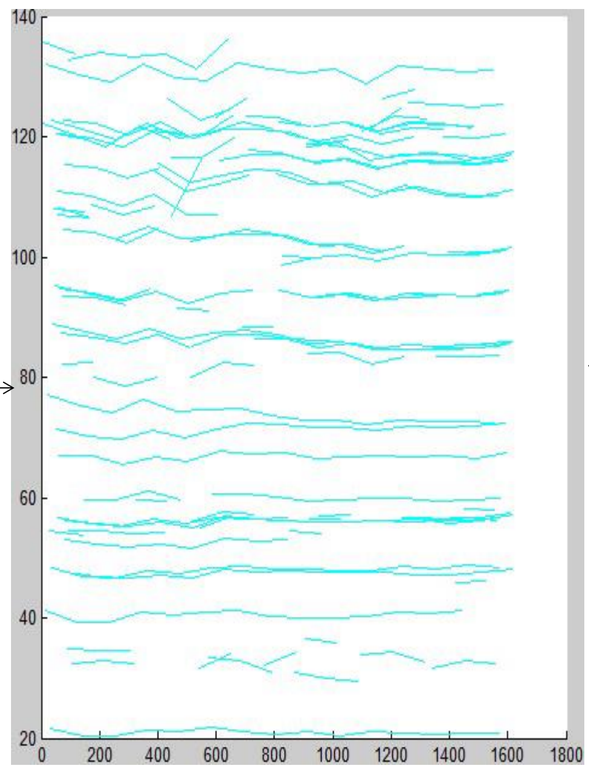
(2)Keyframes trajectory curves



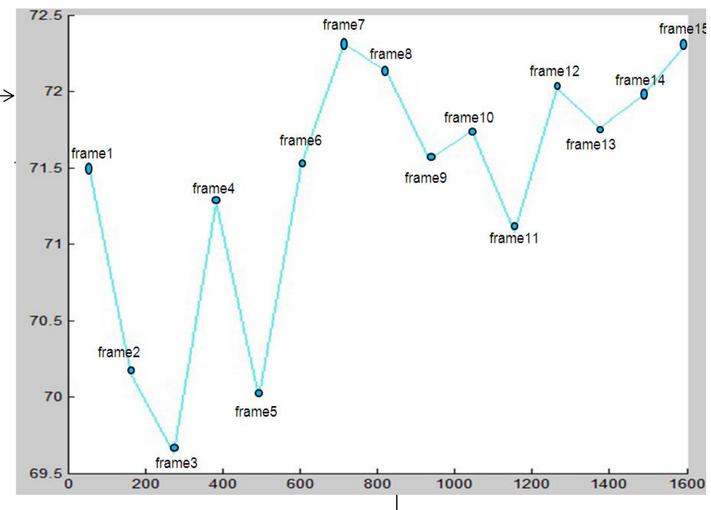
Keypoint



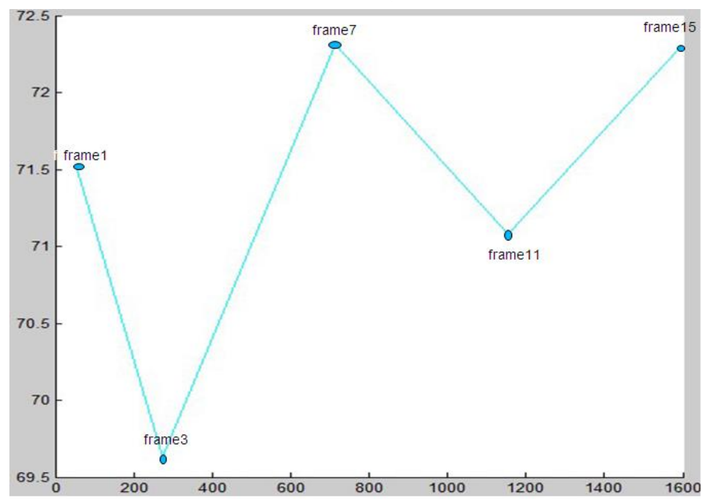
Keypoint matching



Trajectory curves



Trajectory curve



Curve simplification

4. Experiments and Results

CK data set

- The whole data set consists of approximately 500 image sequences from 100 subjects ranged in age from 18 to 30 years, of which 65% are female.

Expression Snippets(keypoint-based)

- This method is the baseline to compare with our research. It uses greedy algorithm to choose keyframes which have the highest influence and positive coverage.

Experiment procedure:

- Keyframes → LBP-top → SVM

The results:

- We compared our method(ES-CS) with the whole sequence and the keypoint-based method(ES-KB).

	Whole sequence	ES-KB	ES-CS
Average number of frames	19.65	7.17	6.28
Accuracy	86.389%	81.668%	83.611%

Case Study:

Whole sequence:

Keyframes:

#15 #1 #4 #11 #5

5 . Future work

- Investigating more advanced curve simplification methods.
- Developing more advanced trajectory features.

6. Conclusion

- Expression snippets provided by curve simplification could capture temporal constraints. Therefore, our research is robust for the motion image sequence.
- The results of demonstrated experiments show that our method for expression snippets get a higher accuracy with the least number.