REU 2013 - Expression Detection in Infants Through Facial Deformation Analysis

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Abstract

We currently still rely on the use of manual monitoring of infants by nurses for pain or discomfort while they are in the maternity ward. Nurses have to look at the babies faces and make a decision to whether or not the infant needs further attending to. We are proposing the application of recent expression detection in video sequences technique to automate this part of infant care. The technique uses an optical flow algorithm that is applied to the face of the infant over an entire video sequence. From this data we calculate an optical strain value for each frame of the video sequence. This strain value can be interpreted and the amount of effort that the infant is putting into making a facial expression. If the strain value is above a certain threshold and matches our definition of an expression then we can deduce that they infant may need attending to. This project presents the performance analysis of current expression detection technique available to the public which shows promising results and accuracy in an ideal test setup. This project also offers a look into the performance developments that need to be made for this application to work completely and accurately.

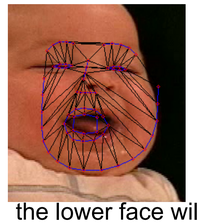
Initial Tests

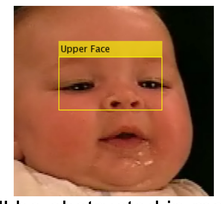
This project is based on recent work done by the USF Computer Vision and Pattern Recognition Group on expression spotting in video sequences. To get an idea of what modifications and developments will be needed to get this idea to work initial tests were performed by running a modified version of the code from [3] on a data set of baby videos from the University of Miami [4]. This data set was chosen as it is one of the only academic data sets providing videos of infants making expressions and that it also came with a robust frame by frame ground truth for expression levels. The data set has provided 4 videos for us to test againsts to asses the initial performance of the algorithm.

Initial Test Results

	1st	2nd	3rd	4th	Overall
# of expression in Ground Truth	3	10	4	11	28
# of Expressions Found	8	9	8	6	31
# of False Positives	4	2	5	5	16
Expressions Found in GT frames	4	7	3	1	15
% of time code expression matches GT expression	50%	87.8%	37.5%	16.7%	48.4%
% of GT expressions found	66.6%	70%	75%	9.09%	46.4%

Initial performance for the code can be seen to the left. As you can see accuracy was less than 50% overall. There are many things that attribute to this. Excessive noise is introduced into the optical strain calculations from inaccurate face tracking and an over abundance of movement from the infants in the video sequences.



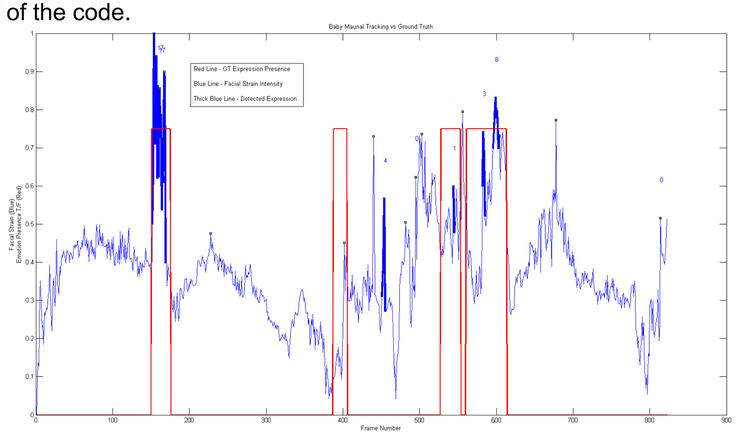


Data Modifications

To overcome the face tracking issues the infants face was manually tracked throughout one of the sequences. Frames representing the inaccurate face point tracking (right) and the more accurate manual upper face tracking (left) can be seen to the left. We only care about the upper face in this application as the lower face will be obstructed in many hospital situations. Video sequence 3 was chosen for the manual tracking as it was the 2nd shortest and offered minimal head movement. Also a short part of sequence 3 was removed that had an abundance of head movement. The sensitivity of the expression detection algorithm was also lowered to try and remove some of the false positives that were appearing at lower strain levels. The definition used in the ground truth was also widened to increase the number of positive ground truth frames to match the sensitivity level of the code.

Second Tests

The results can be seen to the right and in the following The lowered noise can be seen in the overall lower strain graph and the number of false positives has been greatly reduced showing a more accurate representation of the algorithm accuracy in this application.



Performance Comparision Before/After Data Modification

	Automated Face Detection	Manual Face Tracking
# of expression in Ground Truth	4	4
# of Expressions Found	9	6
# of False Positives	7	1
Expressions Found in GT frames	2	5
% of time code agrees with GT	22.22%	83.33%
% of GT expressions found	50%	75%

References

1. S. Godavarthy, “Micro-Expression Spotting in Video Using Optical Strain.” Masters Thesis. University of South Florida, 2010.

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3. M. Shreve, D. Goldgof, S. Sarkar, S. Felilatyev, T. Luguev, “Automatic Expression Spotting In Videos” University of South Florida, 2013.

4. Messinger, D. S., Mahoor, M., Chow, S., & Cohn, J. F. (2009). Infant Smiling Dynamics and Perceived Positive Emotion. Infancy, 14.

Acknowledgements

Dr. Dmitry Goldgof
- Summer REU Mentor

Matthew Shreve
- PD. D. Candidate, Lead author on paper that this project is based on.

Dr. Miguel Labrador
- REU program director

This work has been supported in part by the National Science Foundation under grant No. 1062160, an REU Site on Ubiquitous Sensing at University of South Florida.

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