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EMOTION RECOGNITION

– ITSG report –

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Abstract

Text of abstract. Short info about: project relevance/importance, inteligent methods used for solving, data involved in the numerical experiments; conclude by the the results obtained.

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Chapter 1

Introduction

1.1 What? Why? How?

We want an objective measurement of the emotions that children experience during the interaction. This requires the development of an application that allows the identification of the emotional states of a preschooler during the course of an activity. We need to associate tasks that children do and the frequency of an emotion. We want to detect emotions through facial expressions. For this association we need artificial intelligence algorithms.

We then use support vector machines to classify the facial expressions and emotions. Support vector machines have been proven useful in a number of pattern recognition tasks including face and facial action recognition.

1.2 Paper structure and original contribution(s)

The research presented in this paper advances the theory, design, and implementation of several particular models.

The main contribution of this report is to present an intelligent algorithm for solving the problem of . . ..

The second contribution of this report consists of building an intuitive, easy-to-use and user friendly software application. Our aim is to build an algorithm that will help . . ..

The third contribution of this thesis consists of . . ..

The present work contains *xyz* bibliographical references and is structured in five chapters as follows.

The first chapter/section is a short introduction in . . ..

The second chapter/section describes ….

The chapter/section 4 details ….

Chapter 2

Scientific Problem

2.1 Problem definition

Give a description of the problem. Explain why it must be solved by an intelligent algorithm. Details the advantages and/or disadvantages of solving the problem by a (some) given method(s).

Precisely define the problem you are addressing (i.e. formally specify the inputs and outputs). Elaborate on why this is an interesting and important problem.

Item example:

- content of item1
- content of item2
- content of item3

Figure example

… (see Figure 2.1)

`Fig/FitEvol-eps-converted-to.pdf`

Figure 2.1: The evolution of the swarm size during the GA generations. This results were obtained for the f_2 test function with 5 dimensions.

Table example: (see Table 2.1)

Algorithm example

… (see Algorithm 1).

Table 2.1: The parameters of the PSO algorithm (the micro level algorithm) used to compute the fitness of a GA chromosome.

Parameter	**Value**
Number of generations	50
Number of function evaluations/generation	10
Number of dimensions of the function to be optimized	5
Learning factor c_1	2
Learning factor c_2	1.8
Inertia weight	$0.5 + \frac{rand()}{2}$

Algorithm 1 SGA - Spin based Genetic AQlgorithm

```
BEGIN
@ Randomly create the initial GA population.
@ Compute the fitness of each individual.
for i=1 TO NoOfGenerations do
  for j=1 TO PopulationSize do
    p ← RandomlySelectParticleFromGrid();
    n ← RandomlySelectParticleFromNeighbors(p);
    @ Crossover(p, n, off);
    @ Compute energy ΔH
    if ΔH satisfy the Ising condition then
      @ Replace(p,off);
    end if
  end for
end for
END
```

Chapter 3

State of art/Related work

Automatically detecting facial expressions has become an increasingly important research area.

In 2000, the Cohn-Kanade database was released for the purpose of promoting research into automatically detecting individual facial expressions. [2] They recorded facial behavior of 210 adults. Participants were 18 to 50 years of age, 69% female, 81%, Euro-American, 13% Afro-American, and 6% other groups. For the CK+ distribution, they have augmented the dataset further to include 593 sequences from 123 subjects. They identified 7 basic emotion categories: Anger, Contempt, Disgust, Fear, Happy, Sadness and Surprise. They uses support vector machines to classify the facial expressions and emotions.

Their results were considerable and the hit rates for each emotion were : Angry - 75.00%, Disgust - 94.74%, Fear - 65.22%, Happy - 100%, Sadness - 68.00%, Surprised - 77.09%, Neutral - 100%. [2]

Tarnowski et. al in their article presented the results of recognition of seven emotional states. Coefficients describing elements of facial expressions, registered for six men aged 26-50, were used. Each subject participated in two sessions. A participant mimicked all seven examined emotional states. As a result, 42 5-second sessions were registered for each user. The entire database contained a total of 252 facial expressions. [4] They used nearest neighbor classifier (3-NN) and two-layer neural network classifier (MLP) with 7 neurons in the hidden layer. The input of the network were six AU, and the output was one of the seven emotional states.

They tested two ways to recognize emotions: a) subject-dependent - for each user separately and b) subject-independent - for all users together. In both cases, for 3-NN classifier, data were randomly divided on the teaching part (70%) and the testing part (30%) and for MLP into three groups: teaching (70%), testing (15%) and validation (15%). In subject-independent approach, the classifier accuracies (CA) for 3-NN and MLP algorithms were respectively 95.5% and 75.9%. For user-independent classification the highest classification accuracy (73%) was achieved for MLP neural network. [4]

Chapter 4

Proposed approach

Useful tools:

- OpenCV (Open source computer vision) is a library of programming functions mainly aimed at real-time computer vision. With OpenCV we can detect landmarks of all the faces found in an image and use them further in emotion detection.

- Scikit-learn is a software machine learning library for Python. It features various classification, regression and clustering algorithms including support vector machines, random forests, gradient boosting, k-means and DBSCAN.

Open Face Facial Action Coding System (FACS) is a system to taxonomize human facial movements by their appearance on the face. Movements of individual facial muscles are encoded by FACS from slight different instant changes in facial appearance. Using FACS it is possible to code nearly any anatomically possible facial expression, deconstructing it into the specific Action Units (AU) that produced the expression. It is a common standard to objectively describe facial expressions.

OpenFace is able to recognize a subset of AUs, specifically: 1, 2, 4, 5, 6, 7, 9, 10, 12, 14, 15, 17, 20, 23, 25, 26, 28, and 45. [3]

AU	Description
1	Inner Brow Raiser
2	Outer Brow Raiser
4	Brow Lowerer
5	Upper Lid Raiser
6	Cheek Raiser
7	Lid Tightener
9	Nose Wrinkler
10	Upper Lip Raiser
11	Nasolabial Deepener
12	Lip Corner Puller
13	Cheek Puffer
14	Dimpler
15	Lip Corner Depressor
16	Lower Lip Depressor
17	Chin Raiser
18	Lip Puckerer
20	Lip stretcher
22	Lip Funneler
23	Lip Tightener
24	Lip Pressor
25	Lips part**
26	Jaw Drop
27	Mouth Stretch
28	Lip Suck
41	Lid droop**
42	Slit
43	Eyes Closed
44	Squint
45	Blink
46	Wink
51	Head turn left
52	Head turn right
53	Head up
54	Head down
55	Head tilt left
56	Head tilt right
57	Head forward
58	Head back
61	Eyes turn left
62	Eyes turn right
63	Eyes up
64	Eyes down

Table 4.1: The action units and their codes

4.1 Dataset

We used for training the the Extended Cohn-Kanade Dataset (CK+). Facial behavior of 210 adults was recorded using two hardware synchronized Panasonic AG-7500 cameras. Participants were 18 to 50 years of age, 69% female, 81%, Euro-American, 13% Afro-American, and 6% other groups. Image sequences for frontal views and 30-degree views were digitized into either 640x490 or 640x480 pixel arrays with 8- bit gray-scale or 24-bit color values. Full details of this database are given in. For the CK+ distribution, they have augmented the dataset further to include 593 sequences from 123 subjects The image sequence vary in duration (i.e. 10 to 60 frames) and incorporate the onset (which is also the neutral frame) to peak formation of the facial expressions. In this Phase there are 4 zipped up files. They relate to:

1) The Images - there are 593 sequences across 123 subjects which are FACS coded at the peak frame. All sequences are from the neutral face to the peak expression. 2) The Landmarks - All sequences are AAM tracked with 68points landmarks for each image. 3) The FACS coded files - for each sequence (593) there is only 1 FACS file, which is the last frame (the peak frame). Each line of the file corresponds to a specific AU and then the intensity. An example is given below. 4) The Emotion coded files - ONLY 327 of the 593 sequences have emotion sequences. This is because these are the only ones the fit the prototypic definition. Like the FACS files, there is only 1 Emotion file for each sequence which is the last frame (the peak frame). There should be only one entry and the number will range from 0-7 (i.e. 0=neutral, 1=anger, 2=contempt, 3=disgust, 4=fear, 5=happy, 6=sadness, 7=surprise).[2]

CAFE [1]

4.2 Training

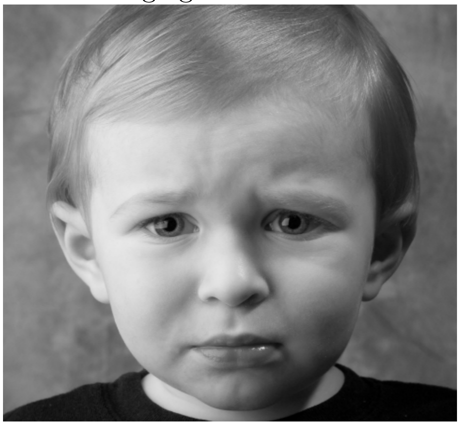
Scikit-learn is a software machine learning library for Python. It features various classification, regression and clustering algorithms including support vector machines, random forests, gradient boosting, k-means and DBSCAN.

4.2.1 Support vector machines

Using Scikit-learn's support vector machines.

4.3 Testing and Results

For an image give the emotion



SADNESS

Chapter 5

Application (numerical validation)

Explain the experimental methodology and the numerical results obtained with your approach and the state of art approache(s).

Try to perform a comparison of several approaches.

Statistical validation of the results.

5.1 Methodology

- What are criteria you are using to evaluate your method?
- What specific hypotheses does your experiment test? Describe the experimental methodology that you used.
- What are the dependent and independent variables?
- What is the training/test data that was used, and why is it realistic or interesting? Exactly what performance data did you collect and how are you presenting and analyzing it? Comparisons to competing methods that address the same problem are particularly useful.

5.2 Data

Describe the used data.

5.3 Results

Present the quantitative results of your experiments. Graphical data presentation such as graphs and histograms are frequently better than tables. What are the basic differences revealed in the data. Are they statistically significant?

5.4 Discussion

- Is your hypothesis supported?
- What conclusions do the results support about the strengths and weaknesses of your method compared to other methods?
- How can the results be explained in terms of the underlying properties of the algorithm and/or the data.

Chapter 6

Conclusion and future work

Try to emphasise the strengths and the weaknesses of your approach. What are the major shortcomings of your current method? For each shortcoming, propose additions or enhancements that would help overcome it.

Briefly summarize the important results and conclusions presented in the paper.

- What are the most important points illustrated by your work?
- How will your results improve future research and applications in the area?

Bibliography

[1] Vanessa LoBue and Cat Thrasher. The child affective facial expression (CAFE) set. Databrary, 2014.

[2] Patrick Lucey, Jeffrey Cohn, Takeo Kanade, Jason Saragih, Zara Ambadar, and Iain Matthews. The extended cohn-kanade dataset (CK+): A complete dataset for action unit and emotion-specified expression. pages 94 – 101, 07 2010.

[3] Yao Chong Lim Tadas Baltrusaitis, Amir Zadeh and Louis-Philippe Morency. Openface 2.0: Facial behavior analysis toolkit. 2018.

[4] Pawel Tarnowski, Marcin Kolodziej, Andrzej Majkowski, and Remigiusz J. Rak. Emotion recognition using facial expressions. pages 1175 – 11184, 06 2017.