First Approach on Automated Psychomorphological Analysis implementation

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Abstract

This is a first attempt to implement an authomation of the psychomorphological analysis throught techniques of deep leaning, machine learning and computer vision.

1 INTRODUCTION and BACKGROUND

Morfopsychology is a phycological discipline, that has established some correlations between the shapes of the different parts of the face and the psychological profile of a person. It has become very trendy in the recent years, but it's origins are very antique. Greeks already knew this correlations and it is known that Hippocrates, Galen, Pythagoras, Aristotle and more recently Leonardo da Vinci , Lavater and Darwin, tried to establish a complete diagnosis based on this principles. From this first attempts, the studies on the matter have become more an more precise, coming from Physiognomy or Characterology till arriving to the actual Morphosychology, due to the works of the beginnings of the last century of psychiatrists Claude Sigaud and Louis Corman, this last considered the founder of this discipline. In recent years, deep learning and computer vision has been applied to multiple fields of human activity and specifically to psychology with some works in the field of "Affective Computation" such as. [1][2] et al. However in the field of psychomorphology after an exhaustive search and consultation with the highest authorities in this field in Spain, there is no record of any work that has attempted to automate any of the used techniques, which seem to be very suitable for this task, as they map directly measurable features of an image of the face to personality. This work is a first approach to the mentioned problem, and is part of a major project that will try to carry out this task for a period of approximately two years.

2 DEFINITION, OBJECTIVES AND MOTIVATION

Morphopsychology can be a good source of information, especially for people who are professionally engaged in human relations and direct contact with the public:

Areas of application of Morphopsychology.

In the business sector it facilitates the process of selection of personnel attending to the needs of the corporation and can be used to achieve a greater harmony between the professional team. It allows to have notions about the personality of the individual (be it partner or client), in order to use the best communicative strategies. In the field of psychology it facilitates the understanding of the preliminary notions of the personality of the patients, helping to establish pre-diagnoses that can make the therapeutic process more fluid. In the field of education and teaching it gives the teachers indicators for an optimization of the capacities of each student and the motivational strategies to employ. Knowing some keys related to the face and personality derived from these traits, teachers can detect some shortcomings and strengths of each of their students, being able to offer a style of teaching more adapted to each student. And a large etc. The main problem with the use of morphosychology, is that there are too many criteria for the analysis, and the high complexity of the mutual influences between them in order to have a final conclusion of the personality makes it very hard for a non advanced specialist to do a precise analysis of the individuals. Usually many years of studying are required in order to have a clear comprehension of all the involved concepts, and the know-how is developed on an intuitional level after many years of practice. The automatization of the diagnosis can help to make morphosicology more accessible to everybody, as it would be enough to have an app in your smartphone, for example, and make a photo in order to have a complete analysis . I can also be useful for teaching morphosicology to the students of this discipline, as the visualization of the concepts and a clear scientifically measurement of them make it easier to be learned.

3 DATA AND ANNOTATIONS

One of the most critical parts of the project was and still is the data mining, as there is no data that can be used directly for our purposes. To obtain the needed data, Sicograf-Institut Mellado was involved in the project, represented by it's founder Mr. Deogracias Mellado and his daughter Ms. Esther Mellado, who are the maximum authorities in this field in Spain and also the first ones to bring this discipline to the country. They are also the founders of the Spanish Asociation of Morphopsycology(which in Spain is also called "Psicomorfologia"), with many published works on this matter, and also in Graphology. As their clients always require a confidentiality agreement, we were not able to obtain already made complete analysis from them, Also the analysis that they already had didn't meet our requirements, so at the end all the data was elaborated

from zero and discussed in many meetings. The first thing in order to have the needed data, was to decide from all the different analysis criteria which ones we were going to implement in this first attempt. The selected ones were the following three:

3.1 Three zones analysis:

the aim of this analysis is to establish which one of the three main zones of the face, the upper/rational (frontal bone of the forehead region), the middle/emotional (eyes/cheeks/nose region), or the lower/instinctive (chin region) are the biggest ones, in order to understand which of these are the dominant treat of the personality.

3.2 Expansion-Retraction analysis:

this analysis looks at the chin as a representation of the vitality of the person, and can be understand as analyzing his tendency of being extroverted,openness, energic, etc.,which is associated to the concept of Expansion and a wide square chin, or the opposite, introversion, selectivity, and a keeping-energy personality, which is associated to the concept of Retraction and a thin triangular chin.

3.3 Triangle of senses analysis:

this one looks at the size of the so called "Little face", which is the trapeze eyebrows-mouth, and it's comparison to the size of the "Big Face",which is the whole face. This concept is associated to concentration-dispersion of the person, his permeability to the exterior influence,etc. The next step was to define some numerical scales for each analysis together with the morphosychologists. This particularly take some work, and had a later influence on the project cause as was mentioned before, their evaluation were more intuitive than numerical. Then the images for the analysis were selected, it was decided to use 50 images of famous people from different professions, those images were found on Google, and they had to meet the next requirements: be frontal or nearly frontal, no tilt, and have as less occlusions on the face as possible, specially on the forehead region, usually covered completely or partially by the haircuts. The images had different sizes, bits per pixel,etc. in order to check which ones were the most efficient for our task. Once this was done, the images were send to Sicograf-Institut Mellado for their evaluation to obtain the ground trouth.

4 METHODOLOGY

The found frontal images were first preprocessed with an image editor, turned so the eyebrow line lies horizontally and cutted to adjust the borders to the face in order to speed-up all the process, and limit the error in some cases like bald people, so the upper border of the image is exactly the forehead border.

The initially chosen method to obtain the measures of the face was the facial landmark localization in it's implementation with frontalization made by Douglas Souza (https://github.com/dougsouza/face-formalization). The initial startegy was to frontality automatically the faces. But after finding that it only frontality the face mask defined in "300 faces in the Wild" but not the forehead, as there were no facial landmarks for this part, the method was rejected, and it was chosen to find directly frontal images in the web and only keep the alinement part.(facial feature detector.py) But the frontal bone of the forehead region was still needed to be calculated, so for this task a region growing algorithm with boundaries parameters was created ,forehead region growing.py.

This two main algorithms were used in the implementation of the three analysis in PM analysis.py. There was a need to understand clearly this three analysis and the way to measure them. After some meetings with SICOGRAF the following methodology was chosen for each analysis:

4.1 Three zones analysis:

From the forehead region growing the area of the forehead in pixels was obtained as the length of the vector of pixels of the region. From the facial landmarks, using the trapeze area formula

$$\text{Area} = (\text{Base}+\text{base}) \cdot \text{Height}/2$$

was calculated the area of each horizontal split of the face defined by the right and left opposite landmarks, from which the distances were calculated as difference of coordinates, and this areas were summed to obtain the areas of the emotional and instinctive zones in pixels. Then all this three areas were sumed to obtain the total area of the Big Face, and the percentage of each zone was calculated in order to see which area was bigger.

4.2 Expansion-Retraction analysis:

for this, the first attempt was to obtain the chin shape from the angles of the chin in degrees, with the cosine formula

$$A^2 = B^2 + C^2 - 2 \cdot A \cdot B \cdot \cos(\alpha)$$

where α is the angle opposite to A, and A, B, C the different distances of the chin left and right angles. Buth this didn't give the desired results, as most of the angles were nearly the same due to the frontal perspective. But this method was kept for future implementation of other analysis. The next attempt was to try to obtain the ground trouth from the ratio between chin heght and width, but after plotting the obtained results it wasn't found any apparent correlation.

So one last idea was implemented: to try to compare the area of the chin with the triangle and square theoretical shapes, adapted to the given image by using the landmarks, and to find to which one of these it was closer via

$$\text{Min - Max ratio} = \frac{\text{Area Chin - Area triangle}}{\text{Area Square - Area Triangle}}.$$

This one give the best linear shape, as it is shown in the following.

4.3 Triangle of senses analysis:

this one was very clear from the beginning, the area of the little face trapeze was calculated from the landmarks, and then the ratio between this and the Big Face area, obtained in the Three zones analysis was obtained.

All these method were called from the main.py file, and give as output all these measurements, that were written down in lreg.py file, where a linear regressor was trained, to obtain the parameters that multiplied by the ratio should give the best approximation of the ground trouth.

Once this coefficients were applied to the ratios in the corresponding analysis it give as an output the following

5 DISCUSSION AND RESULTS

The main issues in the implementation of the automatic analysis was to obtain the ground trouth, as was mentioned before. Morphosychologists usually work on a concept level, and doesn't give any quantitative measurement to this. So this first attempt has the difficulty to establish a proper value scale, which was also needed to be learned by the specialists and used for the first time in a way so the values are consistent between different images. The difficulties to coordinate the agendas and the lack of time made it a hard process, as every change needed to be coordinated between both teams and discussed in a meeting. Another source of error was the facial landmark alignment noise, the algorithm is very sensitive to occlusions as eyeglasses and beard, and also give a bad result on people with meaty jowl. This cases were considered as outliers and erased from the record.

The last source of error was the selection of the images itself, as the same person, depending on the illumination, the pose and the expression can give very different results. We needed In the ideal case we would need a passport type photography, with relaxed natural expression and natural uniform light with the less shadows possible, as it affects the region growing and he alignment, but they were not available on the web in most cases. This three points had his influence in the final results, specially in the case of the three zones analysis, where discrepancies between our predictions and the ground trouth are more notorious and require still a lot of work to establish some coefficients to model linearly our predictions, that will be done in the future. The Expansion-Retraction and the Triangle of senses analysis give an average mean square error of 1.80910656857 and 1.44366166581 respectively. This errors are more or less acceptable, as was confirmed by Sicograf, as they say that in they predictions one point up or down don't make a real difference, but is also planned to be improved in the next months. The final results can be found in the Annex "Final punctuation table".

6 CONCLUSIONS

As always happens, beginnings are hard! There is a need to improve a lot of aspects of the project, as the alignment, and we are planning to create a new algorithm that will find landmarks with less noise and considering also the forehead, not just the mask. Once this will be done, we will be able to use the frontalization algorithm of Douglas Souza to obtain a better images for the posterior analysis and discard the region growing to obtain the forehead area. Also there is a need to work closely with Sicograf-Institut Mellado to obtain more data and to redefine some of the value scales, and we are currently trying to define an agreement of collaboration for the next two years, which once signed, will allow us to a have a team of specialists to generate all the needed data to improve and implement more analysis criteria or even use NN to do a much more advanced approach to this matter.

7 REFERENCES

[1] Escalera, S., Torres-Torres, M., Martinez, B., Baró, X., Escalante, H.J., Guyon, I., Tzimiropoulos, G., Corneou,C., Simón, M.O., Bagheri, M.A. & Valstar,M., (2016) *ChaLearn Looking at People and Faces of the World: Face Analysis Workshop and Challenge* 2016, CVPRW, CVPR. Slides.

[2] Escalera,S., Gonzalez,J., Baró, X., Alonso,F. & Mackay,M. (2016) Care Respite: a remote monitoring eHealth system for improving ambient assisted living, *Human Motion Analysis for Healthcare Applications*, IET London: Savoy Place.