

Plataforma web para el análisis de la gesticulación facial

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What is Face Analysis?

- The analysis of facial expressions constitutes a critical and complex portion of our non-verbal social interactions.

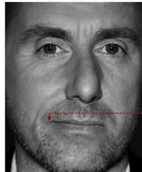
Facial Expression Recognition is focused on classification of the structure of the face into a set of general emotions.

Facial Expression Analysis is focused on measuring how these emotions are produced in the face.



sadness

- ① drooping upper eyelids
- ② losing focus in eyes
- ③ slight pulling down of lip corners



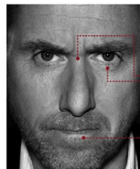
contempt

- ① lip corner tightened and raised on only one side of face



surprise

- Lasts for only one second:
- ① eyebrows raised
 - ② eyes widened
 - ③ mouth open



anger

- ① eyebrows down and together
- ② eyes glare
- ③ narrowing of the lips



disgust

- ① nose wrinkling
- ② upper lip raised



fear

- ① eyebrows raised and pulled together
- ② raised upper eyelids
- ③ tensed lower eyelids
- ④ lips slightly stretched horizontally back to ears

Facial Gestures Recognition

- There are three main steps for working in facial gestures recognition:
 - ① Face detection,
 - ② Extraction of facial gestures information, and
 - ③ Classification of the information extracted.
- .
- The methods for facial gesture analysis can be grouped in **deformation** extraction and **motion** extraction.

Motivation

- Human interaction is very important in many different aspects in our daily life, such as business meeting, medical diagnostics, etc.
- However, thanks to the improvement of technology, this operations can be done remotely, which can be especially useful when the distance is considered a barrier, but this producess another problem which is the lack of physical gesture apreciation.



Figura: Example of the lack of physical gesture appreciation

Problem Statement

Problem

Given a sequence of images from the face, taken in a client computer, where the illumination conditions and background motion are restricted, the problem of analyzing facial gestures on the web, could be stated as an architecture that allows transmission of compressed images through a web service, in order to produce an analysis of facial gestures.

- From this we state the following research questions:
 - ① Considering the speed of internet connections in México, what techniques can be used to increase the speed of image transfer?
 - ② Which type of web service is more suitable for image transmission/analysis?

Objectives

General

Design a web architecture that allows the efficient transmission of facial image sequences to compute an analysis about the behaviour of facial gesticulations, in order to obtain symmetrical / asymmetrical motion patterns which might be used for the decision-making process.

Objectives

Specific

- 1 Implement an image compression technique that allows fast Internet broadcasting.
- 2 Design and implement a web architecture for the reception and decompression of compressed images.
- 3 Adapt a given algorithm for the analysis of gesticulations in the transmitted images.
- 4 Design a set of experiments to test the web architecture.

Scope and Constraints

- The proposed architecture focuses only on the compression-transmission process of images, and does not consider the motion from other regions of the body.
- Moreover, the mechanisms for the analysis of the image sequences were generated in collaboration with researchers of the Universidad Politécnica de Victoria and were only used, but not implemented.

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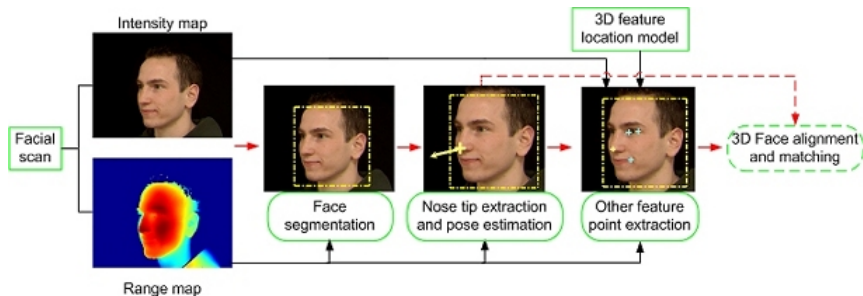
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Facial Gesture Analysis Techniques

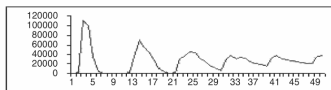
- The analysis problem has been approached from two main streams [3]: facial deformation extraction models and facial motion extraction models (both 2D or 3D).
- **2D based techniques.**
Advantages: fast processing. Disadvantages: very large training data sets is needed to model environment variations.
- **3D based approaches.**
Advantages: higher accuracy [2]. Disadvantages: Higher computational complexity.

- Therefore...

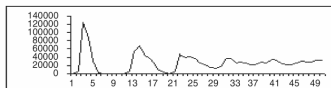


Spiking Neural Networks

(a)



(b)



(c)

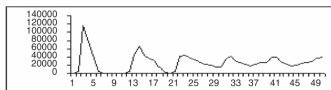


Figura: Obtained results: (a) Left-Right Eyes, (b) Left-Right Nose, (c) Left-Right Mouth

Web Services

- SOAP: Simple Object Access Protocol [8]. It was designed to be a platform and language-neutral alternative to previous middleware technologies.
- REST: Representative State Transfer [4]. A later evolution to SOAP disadvantages.

- Since 3D images are heavier, it is necessary to implement an image compression technique. Basically they can be divided into:
- Lossless Compression Techniques: The feature of the lossless compression technique is that the original image can be perfectly recovered from the compressed image [5] (such as Run length encoding, Huffman encoding, etc.).
- Lossy Compression Technique provide higher compression ratio than lossless compression (such as Vector quantization, Fractal coding, etc.).

- The experimental design is a key piece in the software development process given that it allows identifying failures in the software before it begins to operate.
- An alternative strategy to test software is the use of Covering Arrays (CAs).
- A Covering Array is a combinatorial object that, with a small number of cases, covers a certain level of interaction of a set of parameters [7].

- A covering array is an $N \times k$ matrix over an alphabet v each $N \times k$ subset contains at least one time each combination from $0, 1, \dots, v - 1^t$, given a positive integer value t .

- Covering Arrays have been an object of study and application in different research areas. Cawse [1] used CAs in the material design, Hedayat et al. [6] used them in medicine and agriculture.

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Methodology

1st Stage In this stage, the different techniques for image compression/decompression were studied, in order to choose a set of them to be implemented and tested. Once the implementations of the selected techniques were made, they were tested and compared to choose one that was integrated into a client application. This client application is responsible of capturing the images for their compression by the selected technique.

Methodology

2nd Stage In this stage, the different approaches for web services were analyzed, to choose the most appropriate solution for the problem to be solved. Also, a local web server was mounted, in order to implement the chosen web service model. Once the web service was implemented, the decompression technique to reverse the technique selected on the previous stage, was setup on the web service, this, in order to connect the client to the server to send the compressed images, and then testing the process of transmission-reception-decompression. Based on the results from the previous tests, the necessary adjustments were made to ensure both the proper functioning of the connection between the client and server, and the reception of the original image as captured by the client.

Methodology

3rd Stage In this stage, the work was focused on the adaptation of the algorithm for facial gestures analysis, since it was originally developed to work in a local environment. This adaptation included a mechanism to interact with the compression/decompression technique previously developed, and a mechanism to retrieve and process the results from the facial gesture analysis algorithm, also, a user interface for displaying the results of the analysis was created.

Methodology

4th Stage In this stage, the work was focused on the adaptation of the algorithm for facial gestures analysis, since it was originally developed to work in a local environment. This adaptation included a mechanism to interact with the compression/decompression technique previously developed, and a mechanism to retrieve and process the results from the facial gesture analysis algorithm, also, a user interface for displaying the results of the analysis was created.

Results

Conclusion

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