BioObserver

ADVANCED FACIAL EXPRESSION ANALYSIS FOR THE STUDY OF HUMAN BEHAVIOR IN VIDEOS

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BioObserver is a facial analysis solution for the **automatic detection and annotation of a person's emotional states and micro-expressions.**

It is a non-invasive software for the individual, since it is based on image processing techniques. It is able to detect basic facial emotions such as "joy", "sadness" or "anger", and also more subtle micro-expressions of the face such as "frown", "blink" or "eyebrows raise".

BioObserver also allows to extract the direction of the gaze and the orientation of the head, to monitor behavioral metrics such as the degree of attention of the individual. In addition to automatically tagging the extracted facial information, the platform allows you to configure additional annotations of events and frames that are considered of interest.

CHARACTERISTICS

- Recognition of **7 basic facial emotions**
- Recognition of **18 facial micro-expressions**
- Tracking of gaze direction and head orientation
- **Intuitive interface:** Configurable emotional dashboard with advanced visualizations
- Automatic analysis and labeling in real time or on pre-recorded video
- Possibility of recording other relevant events
- Results exportable to **PDF**

In addition to the OnPremise version **BioObserver Cloud** offers the following features:

- Subscription **based payment model**
- **One account Multiple User** at the same time
- **Cloud Video Storage Space** on demand

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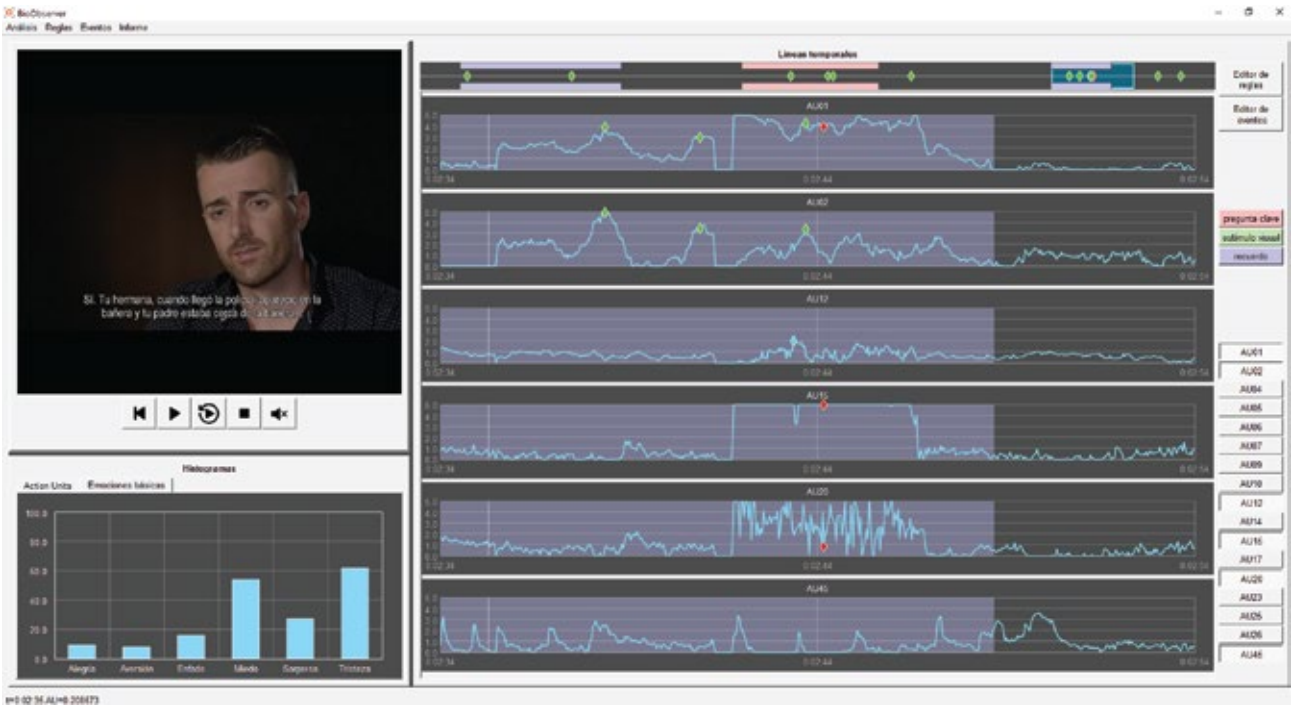
Why facial expressions and behavior analysis?

The automatic analysis of facial expressions is motivated by the **essential role that the face plays in our emotional and social life.** Facial expression is one of the most compelling and natural means that human beings have to communicate our emotions, intentions, clarify and emphasize what we say, as well as to indicate understanding and disagreement. Furthermore, unlike other non-verbal channels, facial expressions are cross-cultural and universal, not depending on the ethnicity, age and gender of the individual.

In the context of an interview or interrogation, the analysis of facial expressions can provide invaluable support to the observer. The spotter can assess, for example, in which specific moments they occur in relation to the question presented: when listening to it, while processing that information; when answering, after having given the answer. It is also interesting for the detection of emotional incongruities, that is, situations in which the subject verbally expresses an emotion while showing a very different one on the face. Likewise, the direction of the gaze and the orientation of the head over time express the degree of attention of the interviewee, giving clues about their interest, abilities and certain personality traits.



Intuitive interface: Configurable emotional dashboard with advanced visualizations

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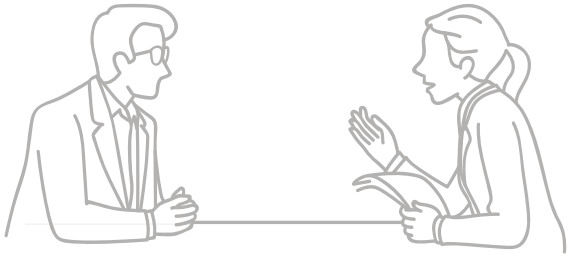

How does BioObserver work?

BioObserver analyzes the face **frame by frame**, either from a pre-recorded video or from a camera capture in real time. It begins by detecting the presence and location of the face within the frame. Next, it extracts a series of characteristic points within the face (for example, around the eyes, eyebrows, nose and mouth), with various purposes. First, to determine the orientation of the gaze and the head. Second, to trim and align the facial region. It is this cropped and aligned image of the face that is finally used for classification in terms of basic emotions, micro-expressions and behavioral metrics.

BioObserver's classification algorithms are based on **Deep Learning**, an advanced Artificial Intelligence technique that uses deep neural networks. These algorithms are capable of automatically extracting the most relevant information from the face, such as patterns and textures (for example, presence of wrinkles around the eyes, shape of the mouth, etc). They have been trained with an extensive database of millions of images of subjects of different ages, genders and ethnicities. This allows BioObserver to maintain a robust and universal behavior, with very high hit rates.

What information does BioObserver provide?

BASIC EMOTIONS

The field of Psychology considers that human beings have a reduced number of basic emotions, from which our entire affective range is built. These emotions are innate, and their corresponding facial expressions are universally recognized.

The 7 most used categories of basic emotions are those proposed by the psychologist Paul Ekman: "joy", "sadness", "fear", "anger", "aversion", "surprise" and "neutral".

BioObserver detects the degree of presence of each of the 7 basic emotions over time, taking values on a scale from 0 to 1, where '0' denotes the absence of the emotion and '1' represents its maximum activation. The results can be viewed in real time through different types of graphics (timelines, histograms and pie charts), and exported to a file.

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FACIAL MICRO-EXPRESSIONS

The human face contains more than 43 muscles. Facial micro-expressions are the result of the activation of one or more of them. These are involuntary gestures, which last a twentieth of a second, and can reveal the state of mind that we want to hide. They are reactions that do not go unnoticed by a well-trained eye, but almost imperceptible to non-expert observers.

Paul Ekman's Facial Action Coding System (FACS) lists all the micro-expressions or Action Units (AUs) that can occur on the face. BioObserver analyzes 18 AUs:

AU1 *"inner brow raiser",*
AU2 *"outer brow raiser",*
AU4 *"frowning",*
AU5 *"upper lid raise",*
AU6 *"cheek raise",*
AU7 *"lids tight",*
AU9 *"nose wrinkler",*
AU10 *"upper lip raise",*
AU12 *"lip corner puller",*
AU14 *"dimpler",*
AU15 *"lip corner depressor",*
AU17 *"chin raiser",*
AU20 *"Lip stretched",*
AU23 *"Lip tightener",*
AU25 *"lips part",*
AU26 *"jaw drop",*
AU28 *"lips suck" and*
AU43 *"eyes closure".*

Its intensity is noted in letters, following Ekman's nomenclature:

A *("trace");*
B *("mild");*
C *("pronounced");*
D *("severe"); or*
E *("maximum").*

The results can be displayed in graphics (timeline and histogram) and exported to a file.

AU	Description	Facial muscle	Example image
1	Inner Brow Raiser	*Frontalis, pars medialis*	
2	Outer Brow Raiser	*Frontalis, pars lateralis*	
4	Brow Lowerer	*Corrugator supercilii, Depressor supercilii*	
5	Upper Lid Raiser	*Levator palpebrae superioris*	
6	Cheek Raiser	*Orbicularis oculi, pars orbitalis*	
7	Lid Tightener	*Orbicularis oculi, pars palpebralis*	
9	Nose Wrinkler	*Levator labii superioris alaquae nasi*	
10	Upper Lip Raiser	*Levator labii superioris*	
12	Lip Corner Puller	*Zygomaticus major*	
14	Dimpler	*Buccinator*	
15	Lip Corner Depressor	*Depressor anguli oris* (a.k.a. *Triangularis*)	
17	Chin Raiser	*Mentalis*	
20	Lip stretcher	*Risorius* with *platysma*	
23	Lip Tightener	*Orbicularis oris*	
25	Lips parted	*Depressor labii inferioris* or relaxation of *Mentalis*, or *Orbicularis oris*	
26	Jaw Drop	*Masseter*, relaxed *Temporalis* and *internal Pterygoid*	
28	Lip Suck	*Orbicularis oris*	
43	Eyes Closed	Relaxation of *Levator palpebrae superioris; Orbicularis oculi, pars palpebralis*	

Cohn, Jeffrey F., Zara Ambadar, and Paul Ekman. "Observer-based measurement of facial expression with the Facial Action Coding System." The handbook of emotion elicitation and assessment 1.3 (2007): 203-221.

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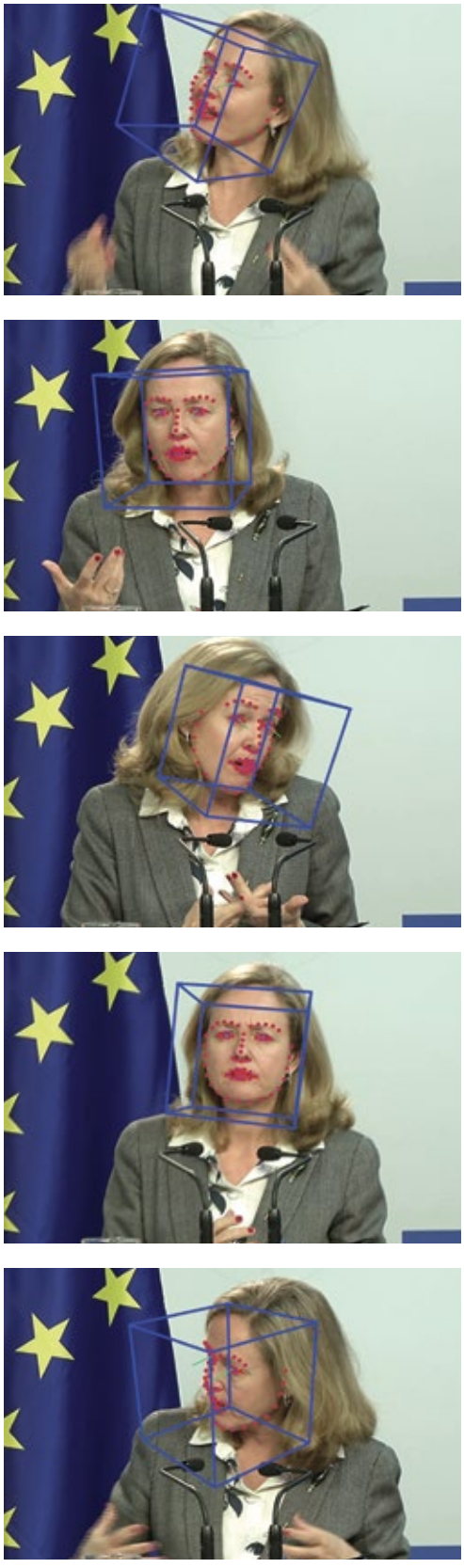

HEAD, GAZE AND ATTENTION ORIENTATION

Head, eyes and their movements are used to direct and capture our attention during a conversation, playing an essential role in social and emotional communication.

BioObserver extracts the orientation of the head (angles) in its 3 dimensions, and determines the direction of the gaze by tracking the pupil. Both are represented in real time superimposed on the video. This information allows to know the degree of attention provided by the individual throughout the recording.

ANNOTATION OF EVENTS, RULES AND EXTRACTION OF KEY PHOTOGRAMS

BioObserver allows the user to define a custom list of events that are considered of interest (for example, the start/end of a key question), and annotate them in real time on the video. It also allows the user to define rules to extract keyframes, based on the activation value of AUs and basic emotions.

Annotations and keyframes can be viewed and exported to a report, categorized under the different types of verbal and non-verbal communication along with the rest of the extracted information (micro-expressions, basic emotions, gaze / head orientation). In this way, the tool allows establishing relationships between events and individual behavior.

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