Affect Lab

Facial Coding

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EMOTION
DRIVES REVENUE

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Overview

Throughout the last decade or two, marketers focused on reaching the right audience or engaging with the right audience based on demographic, geographic or behavioural across real, virtual and augmented reality cross-sections. While the landscape may be evolving quickly, the underlying consumers whom we are trying to reach are still the same.

According to Harvard Professor Gerald Zaltman, ***"95% of purchase decision making are subconscious and are driven by emotions"***, so it is imperative that when marketing a product or a service to a consumer, it's most effective to target the emotional state of subconscious mind. Emotions determine the quality of our lives and the underlying decisions that directly impacts our lives. They influence brand and purchase decisions that we make subconsciously. Hence emotions play a key role in creating a long lasting value for a brand and also directly impacting the commercial success. Facial expressions are spontaneous and difficult to suppress as the muscles responsible for their change are directly linked to the brain.

> ***Emotional Engagement and Attention Grab are key critical factors in making an effective advertisement, but traditional methods to elicit these key data points accurately have failed hence resulting in lot of wasted marketing spend and worse creating a negative impact on the brand***

With the advancements in Artificial Intelligence (AI) and automation, it is now possible for us to measure people's emotions as they watch video content or browse website or perform any activity online - thus truly measuring the efficacy and relevance of the content. Affect Lab's facial coding technology enables brands to utilize this advanced method to measure and identify creatives that will provide the best ROI on their marketing spend.

People view content on their own devices, whenever and wherever with or without clutter - as close as we can get to replicating a real-life viewing experience. People will be exposed to content based on the sequence in which it has been set up by the brand in the Affect Lab SaaS platform

CLOUD SERVER

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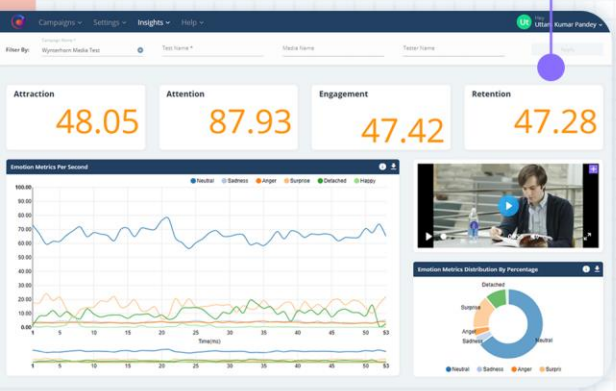
FACIAL AI ENGINE



Their responses are automatically recorded through their webcams with their consent. These recordings are streamed to our cloud servers where the Affect Lab Facial AI engine cleanses and processes the data on every frame and classifies every second of their experience into different emotions based on their facial expressions. The results are then aggregated and reported on our dashboards in real-time, enabling our clients to make better business decisions.

A facial expression is a gesture executed with the facial muscles, which convey the emotional state of the subject to observers. An expression sends a message about a person's internal feeling. In Hebrew, the word for "face"- יִפְנֶה ,has the same letters as the word represents "within" or "inside"- יִפְנִה. That similarity implies about the facial expression most important role- being a channel of nonverbal communication.

Facial expressions are a primary means of conveying nonverbal information among humans, though many animal species display facial expressions too. Although humans developed a very wide range and powerful of verbal languages, facial expression role in interactions remains essential, and sometimes even critical. Across the globe, people rely on facial expressions to communicate how they think and feel to others without uttering a single word. By capturing and analyzing people's facial expressions through their webcams in their natural setting while they watch videos - Affect Lab measures their emotions, without ever seeing their face in-person.

By using Computer Vision and advanced machine learning applied with Paul Ekman's Facial Action Coding System (FACS), we teach computers to recognize people's facial expressions and associate them with correct emotions, the same way people subconsciously do in real-life.

Right from a very young age, humans learn subconsciously how to read and interpret emotions exhibited by other people. Over the periods, humans have become extremely good at recognizing emotions due to the large data set they have encountered while growing up. People have learnt how to differentiate frowning from smiling and other emotions irrespective of male, female, of a different ethnicity, in front of them or via webcam, and so on. Affect Lab teaches the algorithms to recognize emotions the same way as we humans have learnt to recognize.

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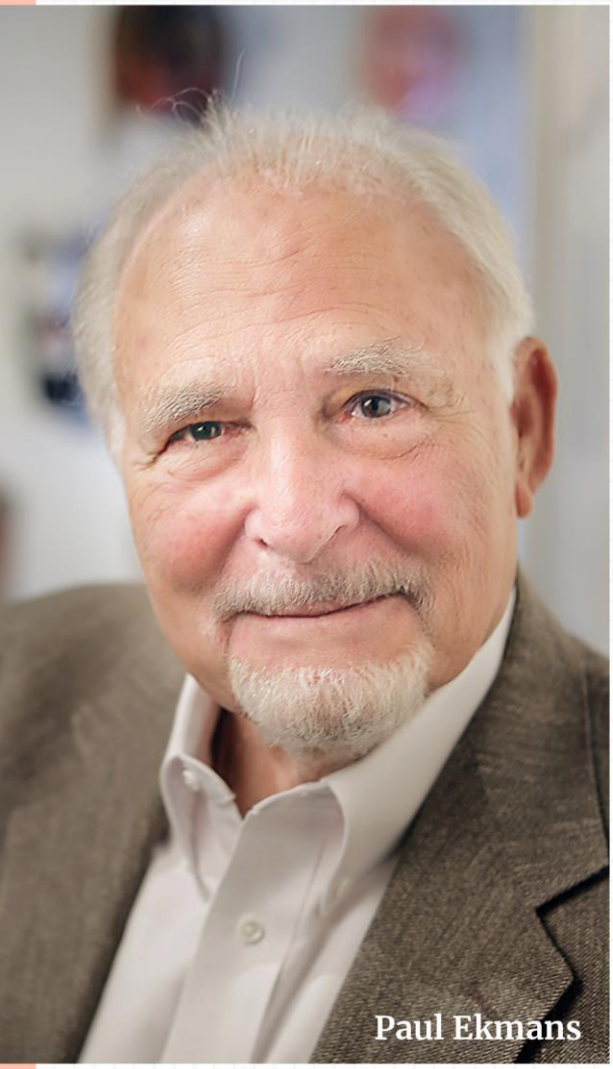
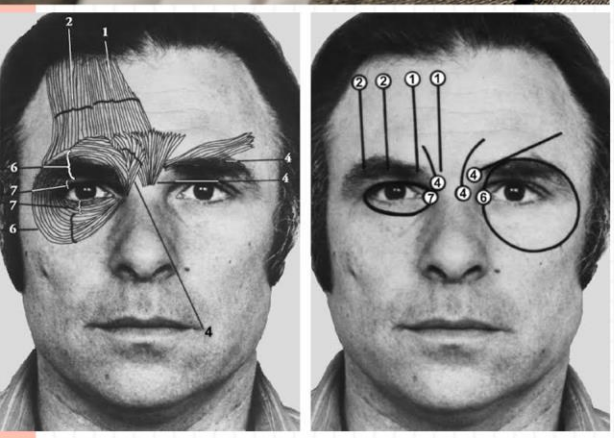
Origin of Facial Expression Analysis

Affect Lab uses a combination of advanced machine learning and Paul Ekman's FACS to classify emotions. Paul Ekmans FACS system is most influenced by Darwin (1872/1997) and Tomkins (1962) based on their study of human emotions in man and animals. Paul Ekman defined certain emotions as basic and the characteristics that was used to distinguish basic emotions are:


Paul Ekmans


FACS System

- Distinctive Universal Signals - Evolution of emotions is driven by what is occurring: inside the person(plans, memories, physiological changes), what most likely occurred before to bring about that expression (antecedents), and what is most likely to occur next (immediate consequences, regulatory attempts, coping). Moods and emotions traits do not own their own distinctive signals, but instead we infer these affective phenomena, in part at least, from the fact that they are saturated with the signals of one or another emotions. Emotions occurs without any evident signals.

- Emotion Specific Physiology - Basic emotions are evolved to deal with fundamental life tasks, they not only provide information through expressions to conspecifics about what is occurring, but there are also physiological changes preparing humans to respond differently in different emotional states.

- Automatic Appraisal Systems - Paul Ekman proposed two appraisal mechanisms, one automatic and the other extended to measure the different expressions exhibited when exposed to different types of stimuli both naturally and induced.

- Universal Antecedent Events - Emotions are viewed as having evolved to deal with fundamental life tasks and thus there will be common elements in the contexts in which emotions are found to occur. This is not to presume that every social context which calls forth an emotion will be the same for all people within or across cultures.

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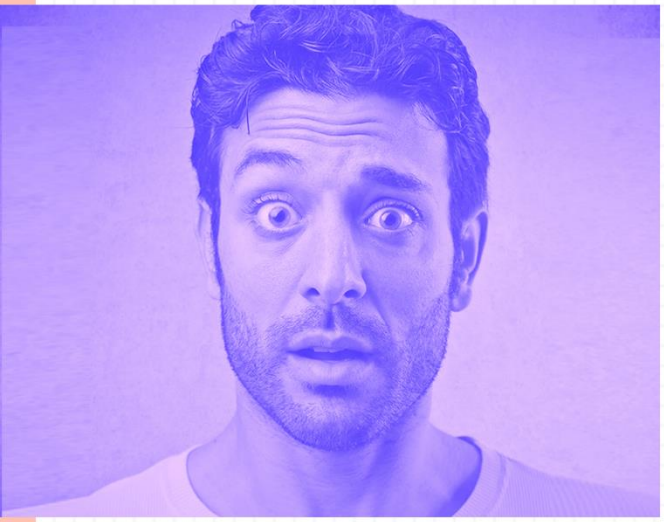
Relation between Facial Expressions and Emotions

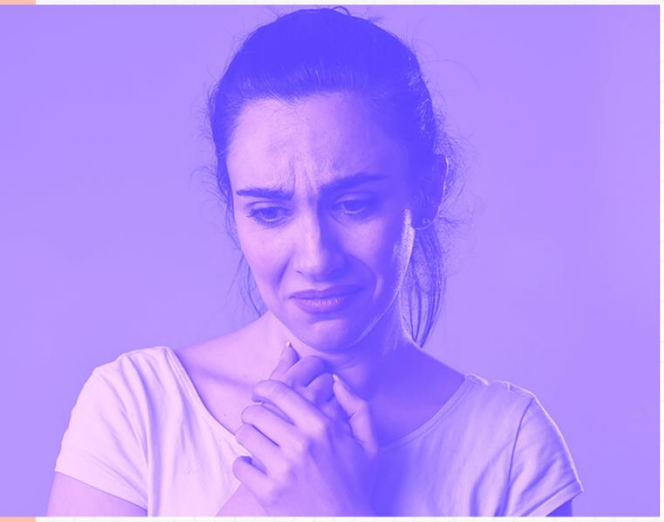
Expressions and emotions go hand in hand, i.e. special combinations of face muscular actions reflect a particular emotion. For example, a person who is trying to ignore his boss's annoying offensive comment by keeping a neutral expression might nevertheless show a brief expression of anger. This phenomenon of a brief, involuntary facial expression shown on the face of humans according to emotions experienced is called 'microexpression'. Microexpressions lasts only 1/25-1/15 of a second. Nonetheless, capturing it can illuminate one's real feelings, whether he wants it or not.

Anger: involves three main features- teeth revealing, eyebrows down and inner side tightening, squinting eyes. The function is clear- preparing for attack. The teeth are ready to bite and threaten enemies, eyes and eyebrows squinting to protect the eyes, but not closing entirely in order to see the enemy.

Fear: involves widened eyes and sometimes open mouth. The function- opening the eyes so wide is suppose to help increasing the visual field (though studies show that it doesn't actually do so) and the fast eye movement, which can assist finding threats. Opening the mouth enables to breath quietly and by that not being revealed by the enemy.

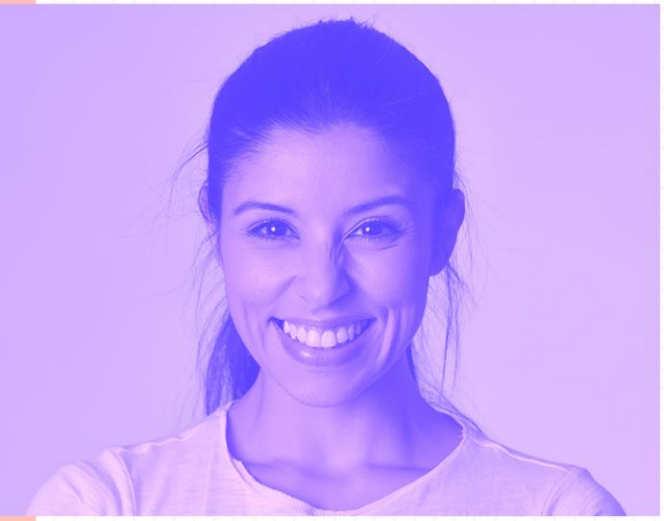


Surprise: very similar to the expression of fear. Maybe because a surprising situation can frighten us for a brief moment, and then it depends whether the surprise is a good or a bad one. Therefore the function is similar.

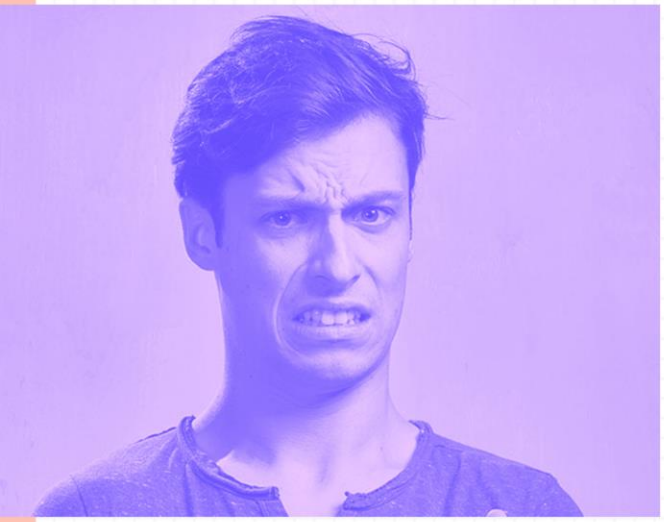


Sadness: involves a slight pulling down of lip corners, inner side of eyebrows is rising. Darwin explained this expression by suppressing the will to cry. The control over the upper lip is greater than the control over the lower lip, and so the lower lip drops. When a person screams during a cry, the eyes are closed in order to protect them from blood pressure that accumulates in the face. So, when we have the urge to cry and we want to stop it, the eyebrows are rising to prevent the eyes from closing.

Contempt: involves lip corner to rise only on one side of the face. Sometimes only one eyebrow rises. This expression might look like half surprise, half happiness. This can imply the person who receives this look that we are surprised by what he said or did (not in a good way) and that we are amused by it. This is obviously an offensive expression that leaves the impression that a person is superior to another person.



Happiness: usually involves a smile- both corner of the mouth rising, the eyes are squinting and wrinkles appear at eyes corners. The initial functional role of the smile, which represents happiness, remains a mystery. A smile encourages the brain to release endorphins that assist lessening pain and resemble a feeling of well being.



Disgust: involves wrinkled nose and mouth. Sometimes even involves tongue coming out. This expression mimics a person that tasted bad food and wants to spit it out, or smelling foul smell.

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Facial Action Coding System Main Action Units

AU CODE	AU NAME	ROI	EMOTION MAPPED	REFERENCE IMAGE
AU1	Inner brow raises	Brow	Sadness, Surprise, Fear	
AU2	Outer brow raiser	Brow	Surprise, Fear	
AU4	Brow lowerer	Brow	Sadness, Fear, Anger	
AU5	Upper lid raiser	Eye	Surprise, Fear, Anger	
AU6	Cheek raiser	Eye, Cheek	Happy	
AU7	Lid tightener	Eye	Fear, Anger	
AU9	Nose wrinkler	Nose	Disgust	
AU12	Lip corner puller	Lips	Happy, Contempt	
AU15	Lip corner	Lips	Sadness, Disgust	
AU23	Lip tightener	Lips	Anger	
AU27	Mouth stretch/open	Lips	--	
AU43	Eyes closed	Eye	--	

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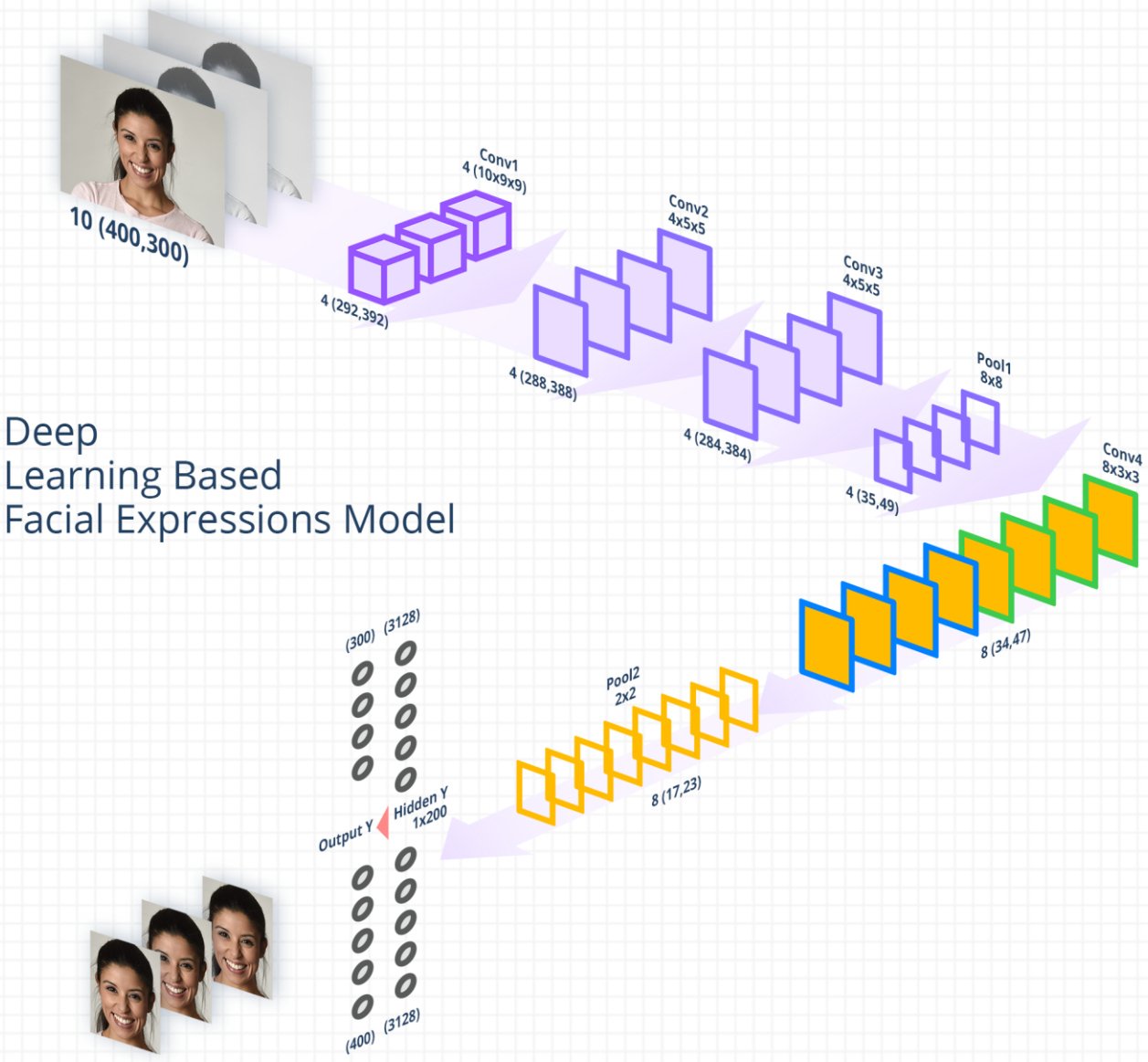
Advanced Machine Learning

Affect Lab also makes use of deep learning, which is based on an artificial neural network with multiple layers between the input and the output. The network moves through the layers calculating the probability of each output.

Currently it is the most successful artificial intelligence technique in machine learning. Like in real neural networks, information on the input side is collected and processed by neurons that are connected with each other. Mapping of input to output goes via a series of nonlinear computations, clubbing together lower levels of information to form higher level features (e.g. expressed emotion).



Deep
Learning Based
Facial Expressions Model

Affect Lab facial coding data set is accumulated based on over 3 years of experiments done across the globe with each frame of the data set tagged by a team of human annotators with detailed descriptors of the key action units, emotions, category, and detailed technical metadata of the frames including the object tags, hsv histogram, pixel density, saturation, composition, and brightness. The facial expressions data set is constantly reviewed and updated to remove any potential bias or ambiguity in tagging emotions.

"Our data set contains over 10+ million frames annotated with different expressions and action units from over 15000+ subjects covering 80+ countries"

Affect Lab data set is also cross trained with Neuro EEG brainwave data for emotion prediction which significantly improves the accuracy of all models due to the nature of the brainwave data. Given that neural activity is the first trigger response for a stimuli in human brain, which then gets translated into facial muscle movements or facial expressions. Affect Lab has also amassed over 5000+ brainwave scans for different types of stimuli covering all the way from advertisements, promos, trailers, to websites, apps and games.

We are continuously working to build worlds largest emotion and facial expression data set tied to different categories, subcategories and subclassifications covering multiple industry verticals. We are the only facial expression prediction engine that takes into account brainwave mapping based emotion classification in addition to Paul Ekmans model and tagged data set.

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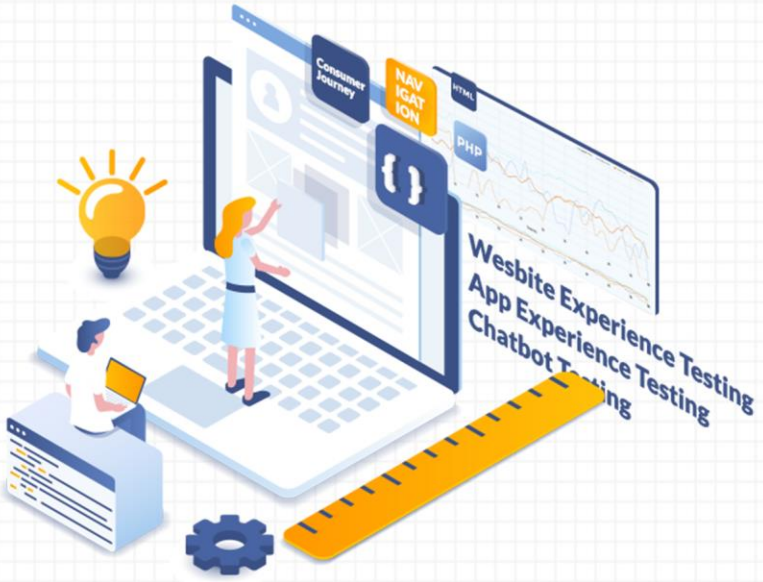
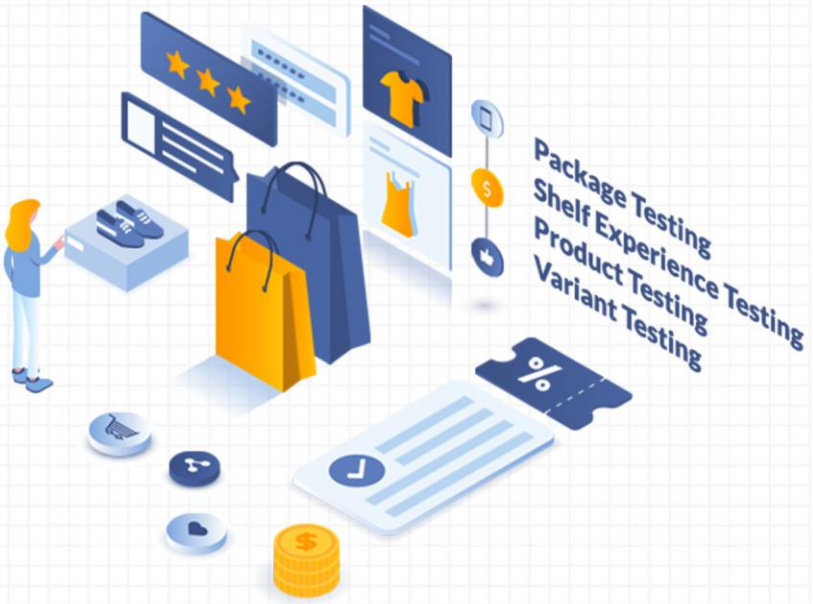
Use Cases

MEDIA EQ

USABILITY EQ



RETAIL EQ



Glossary of terms

- **Action Units:** A small visible movement in facial muscle
- **Annotators:** Person responsible to give machines the categories to learn.
- **Artificial Neural Network:** Mathematical Algorithms to make machines learn using brain inspired neurons.
- **Augmented Reality:** (**AR**) is an interactive experience of a real-world environment where the objects that reside in the real-world are enhanced by computer-generated perceptual information
- **Clutter:** It is a confusing, or disorderly, state or collection of Items.
- **Computation:** Computer Vision: A field of computer science devoted to understanding visual data.
- **Deep Learning:** It is part of a broader family of machine learning methods based on artificial neural networks.
- **Demographics:** It is the statistical distribution of Human populations. Demographic analysis can cover whole societies or groups defined by criteria such as education, nationality, religion, and ethnicity.
- **EEG:** Electroencephalogram, set of sensors used to measure electrical activity of the brain.
- **FACS:** Facial Action Coding System, used to give objective categories to facial movements.
- **Gesture:** It is the innate result of a voluntary and an involuntary emotional response occurring simultaneously and conflicting with one another.
- **HSV:** Hue Saturation Value, this colour system is used to represent colours in more human way than RGB.
- **Machine Learning: (ML)** is the scientific study of algorithms and statistical models that computer systems use in order to perform a specific task effectively without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence.
- **Micro expressions:** It is the innate result of a voluntary and an involuntary emotional response occurring simultaneously and conflicting with one another. This occurs when the amygdala (the emotion centre of the brain) responds appropriately to the stimuli that the individual experiences and the individual wishes to conceal this specific emotion.
- **Artificial Neural Networks:** (**ANN**) are computing systems that are inspired by, but not necessarily identical to, the biological neural networks that constitute animal brains. Such systems "learn" to perform tasks by considering examples, generally without being programmed with any task-specific rules.
- **Physiological:** Related to body and it's functions.
- **Probability:** It is a measure quantifying the likelihood that events will occur.
- **ROI: Return on Investment** is a ratio between the net profit and cost of investment resulting from an investment of some resources.
- **SAAS: Software as a Service** is a software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted.
- **Virtual Reality:** (**VR**) is an experience taking place within simulated and immersive environments that can be similar to or completely different from the real world.

Source

1. Basic Emotions, Chapter 3 by Paul Ekman
2. The expression of the emotions in man and animals by Charles Darwin
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9. Consulting Psychologists Press, Palo Alto, 1978 / [Ekman and Friesen, 1978] Ekman, P., and Friesen, W

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