

What Galvanic Skin Response technology tells us about emotional arousal



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Reading time 9 mins

Key Points

- Galvanic Skin Response (GSR) technologies measure the electrical conductivity of the skin in response to stimuli and give insights into the intensity of the emotional arousal that elicited the response
- In psychiatry, GSR technology is being used to help treat anxiety, depression, and suicidal tendencies
- As a biofeedback therapy, studies are being conducted to determine the effectiveness of GSR for patients with drug-resistant epilepsy
- GSR devices are also being used to complement pharmacological treatments for the neurorehabilitation of disorders such as schizophrenia
- Because GSR technology measures the intensity of the emotion and not the type of emotion (i.e. a positive emotion such as joy or a negative emotion such as stress), they work best when complemented with other biosensors such as an Electroencephalography (EEG) or Electromyographic sensors (EMG)

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As we continue to explore the latest trends in digital health, biosensor technologies focusing on Galvanic Skin Response (GSR) merit some time under the spotlight. While the majority of health technologies we've looked at relate to how the body is doing (e.g. wearables that continuously monitor glucose levels, heart activity, and respiration rate), we've yet to explore those designed to provide insights on what the body-mind is feeling based on its state of emotional arousal.

GSR technologies aim to do just that. [Electrodermal](#) devices [measure sympathetic nervous system responses](#) (e.g., sweating) to determine people's emotional states through arousal. An example of a galvanic skin response technology that most of us are familiar with is the polygraph (lie detector test). Although the accuracy of polygraphs is debatable (there are no specific physiological reactions associated with deception), they have paved the way for GSR innovation in healthcare fields such as [psychiatry and neurorehabilitation for disorders](#) such as drug-resistant epilepsy and somatic pain.

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How do GSR technologies work?

Sometimes called Electrodermal Activity (EDA) or skin conductance, [galvanic skin response](#) measures emotion—specifically, the skin’s electrical conductivity in response to stimuli. When we experience something emotional (e.g. anger, fear, or joy), we trigger our sweat glands in subtle ways that we are often unaware of, and our skin becomes more conductive to electricity. Galvanic skin response technologies can measure these minute variations in the conductivity of our skin in response to specific stimuli.

What makes GSR an attractive tool as opposed to other ways of measuring emotion (e.g. pupil dilation or facial expressions) is that rapid changes in skin conductance are automatic and are driven by our autonomic nervous system, meaning that they happen unconsciously or without cognitive control. GSR technologies are beneficial for people or patients who cannot speak, articulate, or communicate their feelings. And for people who want to hide or deny their feelings, these tools could be invaluable.

The [setup for GSR sensors](#) is relatively straightforward:

- 2 electrodes are attached to 2 emotionally sensitive locations on the body (e.g. fingers)
- An amplifier boosts the signal’s amplitude, and a digitiser converts raw analogue signals into binary streams
- The voltage difference across the electrodes calculates skin conductivity
- In stress, tension, or anxiety situations, sweat secretion and conductance increase, and the skin’s resistance decreases. In a case of satisfaction or relaxation, the opposite occurs
- This allows conclusions on their emotional state (e.g. bored, relaxed, engaged, scared) during that experience to be made

What are GSR devices’ limitations?

The key limitation of GSR devices is that they effectively measure the intensity of emotional arousal but not the type of emotion itself (e.g. excitement vs fear) – making it difficult to tell if the experience was positive or negative. For this reason, galvanic skin response technology is not recommended as a stand-alone measure. It should be used along with other [types of body sensors](#) for further insights into what prompted the emotional reaction.

Examples of [complementary biosensors](#) which could be used with GSR devices:

Eye tracking: GSR measurements can be validated or contextualised by monitoring the dilation and constriction of the pupils (which are known to correlate with emotional arousal). For example, more insights can be gained into what triggered a response by observing what or where a participant was looking.

Facial expression monitors: Issues with [Emotion valance](#) (the extent to which an emotion is positive or negative) can be addressed by monitoring the changes in facial expressions.

Electroencephalography (EEG): A neuroimaging technique that measures electrical activity on the scalp. It tells us which part of the brain is active during exposure to a stimulus as emotions arise from [activity in distinct regions of the brain](#).

Electromyographic sensors (EMG): Monitors muscular responses to a stimulus (e.g. startle reflex). [Wearable facial EMG devices](#) can further test or monitor emotional valence, as even subtle muscle activation patterns can be noted.

Galvanic skin response technology applications in healthcare

The [biofeedback](#) (electronic monitoring of automatic body functions) capabilities of GSR technologies make them valuable in healthcare. Because they measure stress, anxiety, and other emotions and can gauge changes or trends over the long term, their applications in stress management, psychiatry and neurorehabilitation have gained considerable interest.

1. [Use of GSR technology in psychiatry](#): Evaluates anxiety and depression disorders, suicidal tendencies, and bipolar affective disorder.
2. [GSR biofeedback training](#) in the management of drug-resistant epilepsy: Provides people with epilepsy with a tool to learn how to voluntarily control physiological signals, which are usually autonomous.
3. [GSR applications to reduce stress](#) and tension by training a relaxation response
4. [Neurorehabilitation treatments](#): When used to complement the pharmacological treatment for patients with schizophrenia, initial test results have been positive. Patients undergoing training sessions on how to self-regulate breathing, relaxation, and concentration showed a statistically significant decrease in measured values.

Do GSR devices have uses outside of healthcare?

Because of the correlations they draw between our mental and physiological states, galvanic skin response technology isn't limited to healthcare. Take product design and development, for example, where customer feedback is needed: GSR could give insights into what survey or focus group participants left unsaid or identify sources of frustration when users engage with the product. These technologies could also help to design intuitive and more user-centred products or processes, thereby improving the user experience and assisting designers in creating impactful or more purposeful products.

Content creators could also gain valuable information regarding viewers' unbiased, unconscious, or emotional responses to what they're watching. The same can be said for a range of situations (e.g. fundraising, artistic performances) that are designed to elicit an emotional response from participants (e.g. donations, entertainment).

A final word on skin sensor devices...

The importance of developing insights into what people are feeling and the factors/stimuli that trigger emotional arousal for some and none for others cannot be downplayed. Not only do these insights help to predict how people might feel in a specific situation, but they also help to make sense of their reactions.

Mental Health, for example, was a highly stigmatised subject in the UK until recently – and still is in many parts of the world. And while conversations around depression, anxiety, stress, and even suicide have entered the mainstream, many people cannot verbalise their emotions as they feel uncomfortable or 'weak' for doing so. The ability of GSR technology to detect emotions that some might downplay as insignificant (or be reticent to admit to) is invaluable.

Which is what makes body sensor technologies so useful. They enable us to efficiently collect objective and accurate data and use it to develop solutions that help people.

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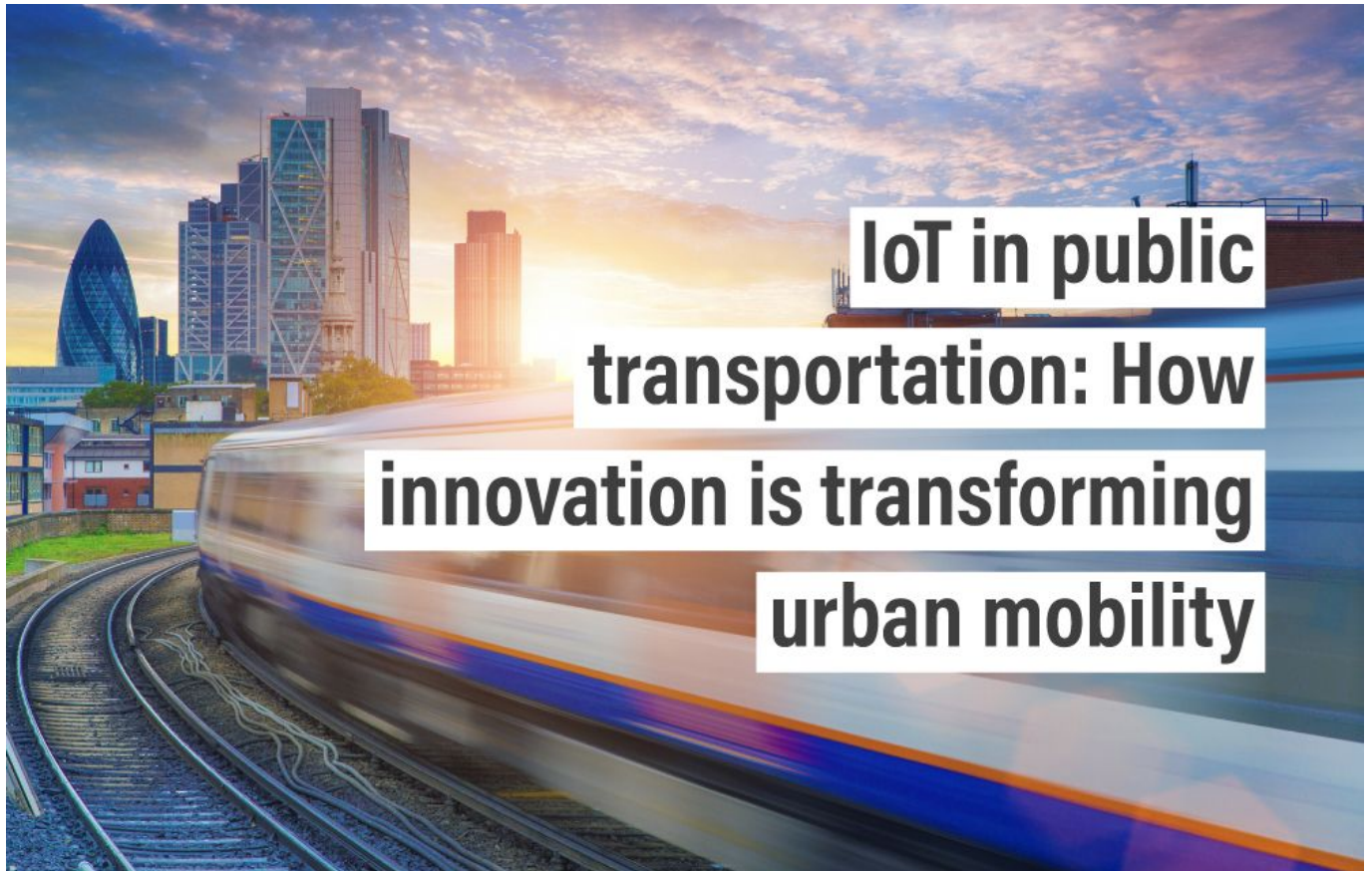
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