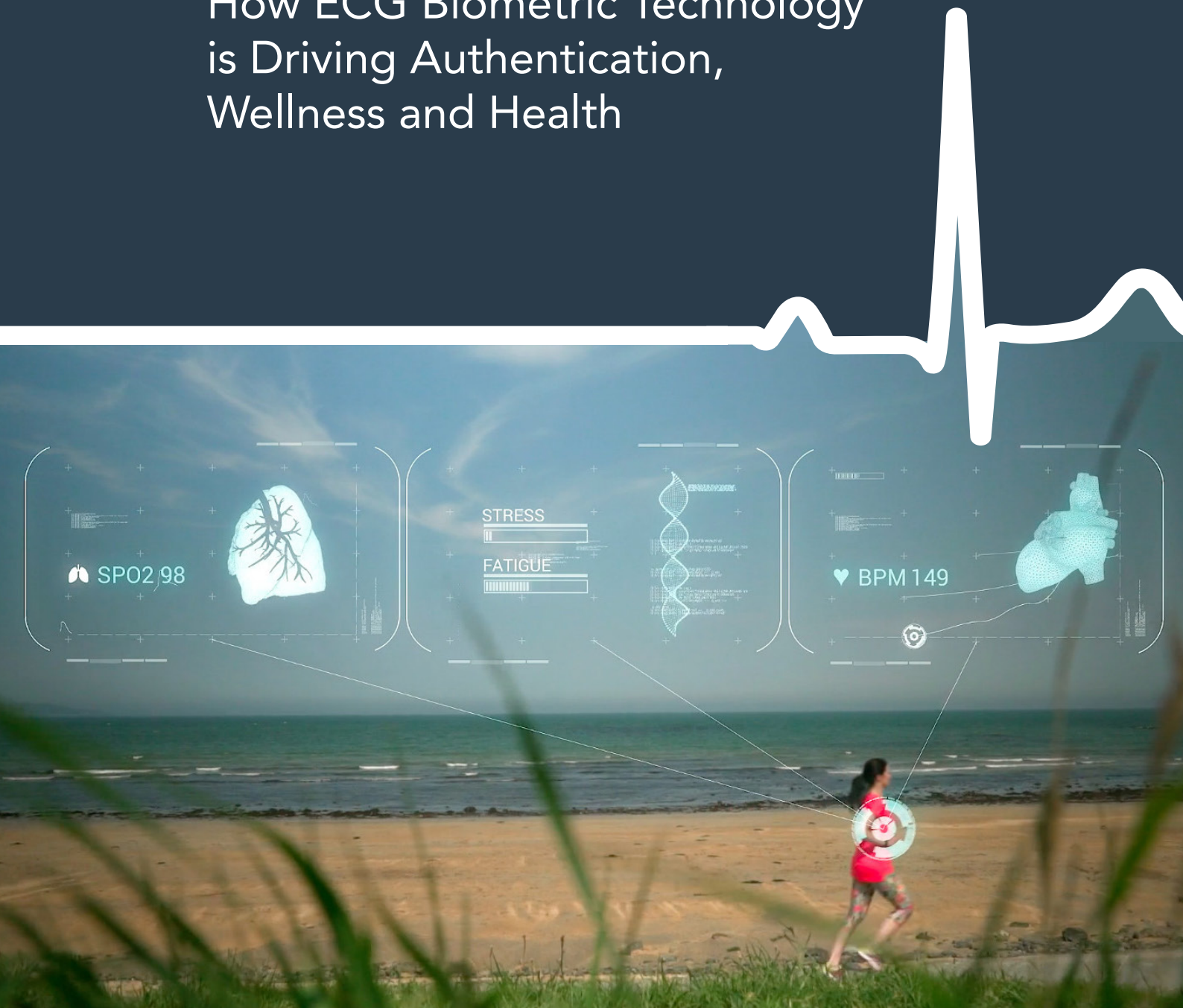




Unlock Your Heart

How ECG Biometric Technology
is Driving Authentication,
Wellness and Health



Contents

Welcome to the Connected World	2
The Genesis of ECG Biometrics	3
How Does ECG Work as a Biometric Authenticator?	4
Securing the Connected World in a Heartbeat	4
Wearable Wellness	5
Automotive	6
Industrial	7
Beyond Authentication to Data Driven Disruption	8
The Challenge	9
The Heart of Our Future	10

Welcome to the Connected World

Consumers are becoming increasingly accustomed to the convenience and personalisation of connected services and devices, and we're not just talking about smartphones. From networked kitchen appliances to connected cars, the IoT is growing exponentially.

As more and more devices and platforms are connected to the internet, the more urgent the need for identity authentication to keep our connected world secure.

Biometrics is rapidly gaining popularity as a powerful authenticator to meet this challenge.

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More than 31 billion connected IoT devices by the end of 2018, including 406m medical devices, 928m automotive 5.9 bn consumer devices.

**Prediction from 'IoT Trend Watch 2018'
IHS Market, 2018¹**

The Power of Biometrics

Biometrics is considered one of the strongest options among existing user authentication techniques due to its six main characteristics: universality, uniqueness, collectability, permanence, acceptability and circumvention.

Biometric authentication systems compare a user's biometric submission against stored data in a database. If both samples of the biometric data match, authentication is confirmed and access is granted. Fingerprint, face, voice and even vein recognition technologies have gained ground in the space, with commercial applications being developed for each.

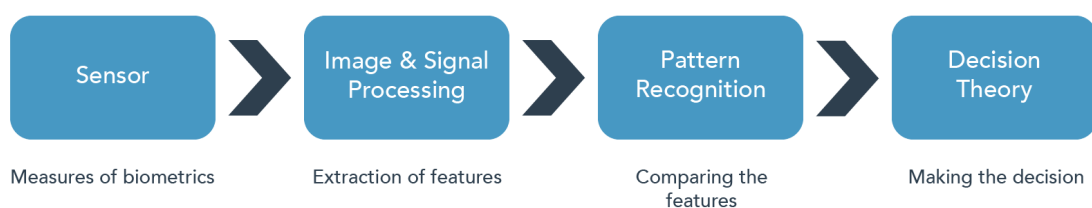


Fig. 1 A typical biometric authentication process

¹ - 'IoT Trend Watch 2018', market report, IHS Markit, 2018.

The Next Wave of Biometrics - ECG

However, newer biometric technologies are already moving forward.

ECG (electrocardiogram) authentication is part of the next generation of biometrics, moving from external modalities to more secure internal ones.

Traditionally used in the cardiac and medical fields, its commercial potential is now being realised in a variety of interesting ways.

What's fascinating to us is to look beyond ECG's authentication power to the possibilities of the data it uncovers.

Could ECG authentication act as a catalyst to unlock deep, data-driven insights into health and wellness? What could that tell us about individuals? And how, or - more saliently - should, we use these insights?

Crucially, if heartbeat data can go beyond telling us who individuals are to how they are at the same time, does this insight have the power to disrupt?



The Genesis of ECG Biometrics

ECG biometrics is born out of medical beginnings, used traditionally in the diagnostics and treatment of cardiac conditions.

The concept that each person has a unique ECG signal has been explored as early as 1977². Further studies have continued through the years including a routine study of over 900 patients' ECG profiles at the Royal Victoria Hospital in Belfast in 1990.

It was noted that various ECG measurement intervals such as P-Q and R-P were all different and thus a disadvantage to that particular study. On the basis of this observation, the inventors realised that this uniqueness was related to the variation in ion-paths, electrical conduction blockages and other structural mechanisms due to the varying morphology of each individual's heart.

2 - Forsen GE, Nelson MR, Staron RJJ. Personal attributes authentication techniques. 1977

Clinical research has helped develop the concept of ECG biometrics, with investigators increasingly interested in identifying how the ECG trace offers a complete and unique individual profile. 'ECG to Identify Individuals' was a particularly important piece of research that used an extensive set of ECG descriptors to define a complete characterisation of a heartbeat trace, and prove that the ECG trace is indeed unique to an individual.³

How Does ECG Work as a Biometric Authenticator?

Biometric recognition using ECG consists of two broad approaches, namely the fiducial points dependent and the non-fiducial methods.

Fiducials are specific points on the ECG heartbeat which can be used to extract features based on its temporal and amplitude characteristics. Non-fiducial methods do not rely on specific points on the ECG curve but rather use statistical characteristics.⁴

A bio-potential signal from each heartbeat is recorded or assessed in real time by a computer system and this bio-potential waveform has parameters that are unique from one person to the next.



Securing the Connected World in a Heartbeat

The ECG has a number of benefits as an authentication modal.

- 1 Internal Security:** As an internal metric, the ECG carries inherent security. It is much more difficult to harvest, spoof or counterfeit an individual's heart rate pattern than other biometrics.
- 2 Liveness Detection:** Liveness detection is also an important differential, with most biometrics operating as a static modal - ECG uses dynamic indicators to confirm aliveness.
- 3 Externally Robust:** The ECG is less affected by environment, in comparison to fingerprint recognition which can be affected by ageing skin, or dampness on the skin and is obviously a metric that all living individuals carry.
- 4 Implementation Ease:** From an implementation perspective, ECG uses sensors that can be manufactured at significantly lower costs, and can be embedded into existing infrastructures more conveniently than other modals, which commonly require wholesale system changes.

3 - 'ECG to Identify Individuals'. Israel, S.A., J.M. Irvine, A. Cheng, M.D. Wiederhold, B.K. Wiederhold. Pattern Recognition, Vol. 38, No.1, 2005, pp. 138-142.

4 - 'Feasibility of Single-Arm Single-Lead ECG Biometrics'. Peter Sam Raj and Dimitrios Hatzinakos. 2014.

- 5 Continuous and Passive:** The primary use cases for ECG biometrics look for authentication once or twice a day, providing a continuous state of authentication which enables passive access onto both physical and logical platforms.

While academic research labs have proved the ECG biometric concept well, private research and development of the technology is likely to drive the market to commercial use. Several key use cases are well underway.

Wearable Wellness

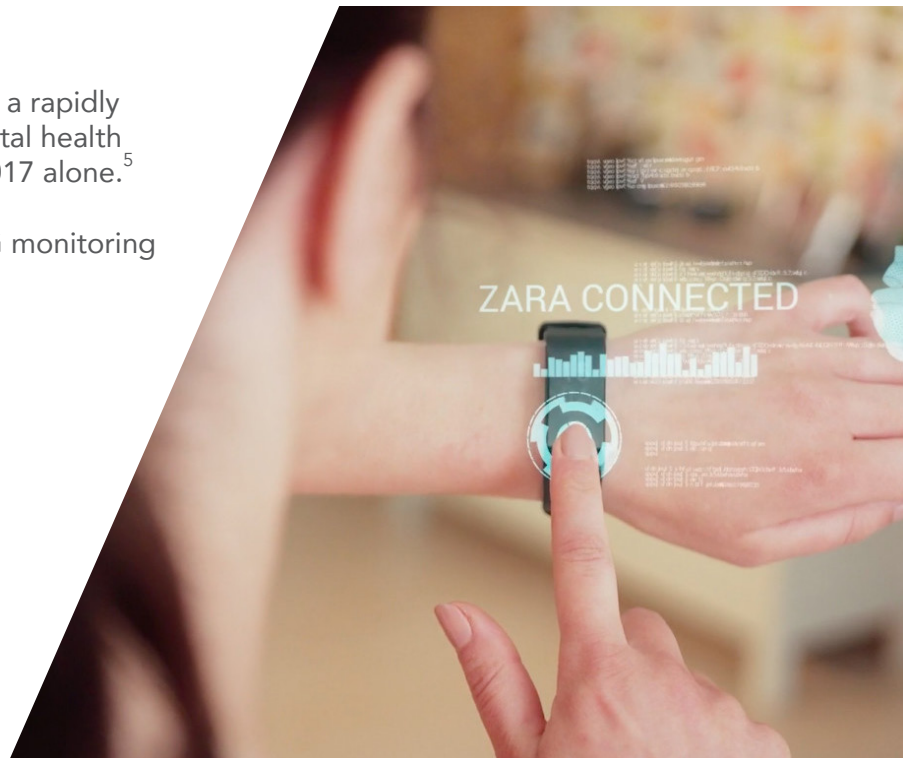
Digital health and wellness intervention is a rapidly growing area. \$3.5bn was invested in digital health innovations in the US in the first half of 2017 alone.⁵

The physiological insights offered by ECG monitoring include an assessment of:

- Heart rate
- Stress levels
- Fatigue and drowsiness
- Respiration
- Atrial fibrillation

These insights could enable consumers to:

- Identify stress and fatigue factors
- Prevent injury and create personalised fitness goals
- Early detection and disease prevention



Expert Insight

Consultant cardiologist Dr Andrew Mitchell views ECG as enormously beneficial for wellness and preventative medicine.

"The rapid development and acceptance of wearable technologies means that an increasing number of the population are carrying devices that can help manage their health as well as their identity.

"The ECG is a unique internal biometric which means that it can't be remotely or externally copied, unlike facial and fingerprint technologies, and relies on the person being alive and present.

5 - 'Digital Health Funding 2017 Midyear Review'. Halle Tecco and Megan Zweig, Rock Health. 2017.



"The additional benefits of having your heart monitored are enormous. Heart rhythm conditions such as atrial fibrillation (AF) affect one in four adults from the age of 40 and, left untreated, can result in stroke or heart failure.

"Many people will have no idea that they have an abnormal heart condition and wearable technologies are now allowing simple heart screening, providing earlier detection and treatment.

"Pairing wearable heart screening technologies with the biometric algorithms from B-Secur makes perfect sense. Not only can dangerous changes in heart rate or rhythm be detected but user identity can be confirmed, geographical locality identified from GPS, thereby allowing earlier intervention from first responders and other linked health providers."

Embedding ECG biometrics into a wearable format brings together health insights and authentication - a powerful combination.

A wearable of this type can also:

- Authenticate payments for cyber-secure transactions
- Access devices from laptops to smartphones
- Secure buildings/vehicles and physical access control

This is a unique offering, with transformative potential.

Automotive

Automotive is another truly exciting area for ECG biometrics to impact.

Extracting heart health insights for drivers could enhance road safety by providing new depths of Vital Signs Monitoring (VSM), alerting them to potentially dangerous physical states.

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25,300 people lost their lives on EU roads in 2017 and another 135,000 were seriously injured. 90% of crashes are linked to human error.

European Commission⁶

⁶ - 'Europe on the Move - Safe, connected and clean mobility'. European Commission, 2018.

ECG adaption into vehicles could turn a car into a sophisticated health monitor, offering insights on:

- Driver drowsiness
- Stress
- Cardiac activity

Armed with these insights, the in-car environment can make intelligent, data-based suggestions to enhance safety.

Imagine the impact of the vehicle being able to:

- Suggest a rest break before the driver becomes fatigued
- Shift into semi-autonomous driver mode until driver alertness returns
- Make recommendations on improving the environment, e.g. soothing music and lighting or lowering the temperature
- Alert the driver to seek help if dangerous cardiac patterns are detected



ECG also allows for individual driver personalisation, allowing each driver's personal in-car experience to be tailored from their apps, driving position and atmosphere to their insurance and even payments.

This personalisation could help fleet management companies, and even the new wave of global car rental schemes manage their customers.

Read more in **ECG Biometrics for the Connected Car**
our download with market research analysts Goode Intelligence

[Read More](#)

Industrial

Another important use case is the monitoring of employees engaged in physically stressful or dangerous work, particularly first responders.

As an example, using a wearable ECG device could help fire chiefs closely monitor firefighters entering a burning building; providing data about who they are, where they are and what physical stresses they are experiencing.

These wearable ECG devices can also connect to any type of IoT monitoring platform, allowing for a central command to monitor the entire workforce. Organisations can access real-time wellness information, allowing them to make real-time decisions, always knowing who and where they are.

ECG sensors embedded into clothing to produce 'smartwear' are already in the marketplace and growing in popularity.

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There were 968,000 smart clothing units sold in 2015, a number that will reach 24.75 billion in 2021—a stunning 71.6 percent CAGR.⁷

Such information could improve critical decision-making and improve first response safety, e.g. identifying that a firefighter is unwell and extracting them from the danger.

The authentication play could come in here too, protecting important physical spaces with continuous authentication.

Airports, government buildings and hospital wards could benefit from this level of security.



Crucially, this type of continuous ECG authentication facilitates long term physiological data capture and the protection of that data, meaning data profiles can be built up per user, not just device, mitigating the risk of data being compromised by other users

Beyond Authentication to Data-Driven Disruption?

Extracting unique physiological, psychological and even sociological indicators from ECG-based technologies could offer new perspectives with the ability to disrupt industries.

Opening up this insight could transform the personalisation of services, and disrupt industries relying on aggregated data models based on demographics or location.

7 - 'Smart Clothing and Body Sensors: Market Analysis and Forecasts'. ReportBuyer, 2016.

One example could be car insurance. Most insurers rely on generalised statistics to predict likely behaviours but consider how ECG biometrics could disrupt this approach.

You enter your car, and instead of inserting a key to ignite the engine, you place your hands on the steering wheel, where biometric sensors take your ECG reading and authenticate the vehicle to start.

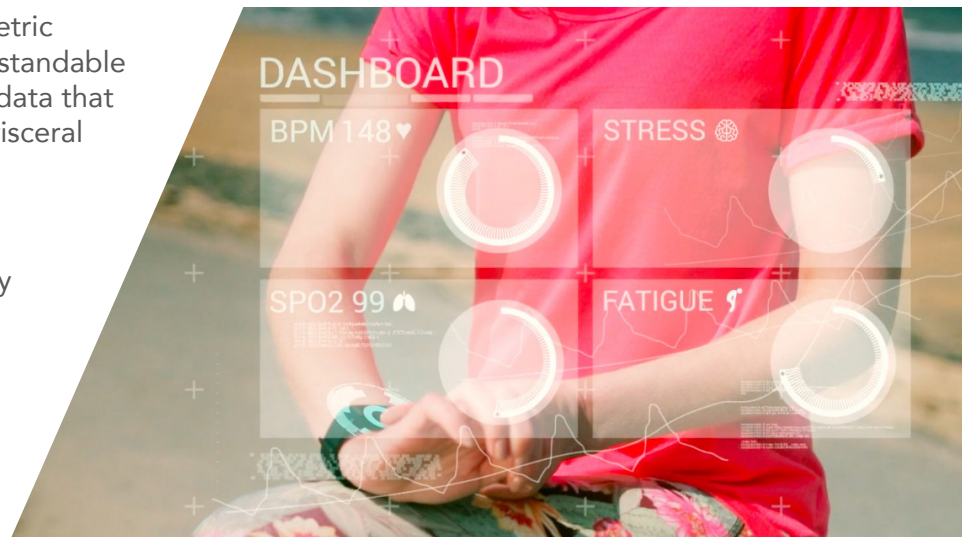
From this interaction, other key physiological factors can be revealed that define your physical state which may, in turn, affect your driving - whether you are stressed, tired or suffering from a medical complaint.

This level of insight could catalyse fundamental changes in industries reliant on general profiles, taking ECG beyond authentication to a powerful disruptor.

The Challenge

Although the power of internal biometric technologies is clear, there are understandable concerns about gathering and using data that is so sensitive, personal and really a visceral part of our basic humanity.

Personal data collection on this level needs to be carefully and thoughtfully considered. Companies will need to manage users' data in line with stringent legislation designed to protect the misuse of personal data, such as the recently-introduced General Data Protection Regulation (GDPR) from the European Union.



Permission to use ECG data will need to be explicitly obtained, and a clear understanding of its collection communicated.

Another concern of biometrics is the impact of a breach. Biometric profiles cannot be reset like a password.

While the internal nature of ECG makes it more difficult to defraud, no one metric can claim to be impervious to attack. A multimodal approach that uses ECG as a secure foundation could be the answer.

Despite privacy concerns, data collection is fast becoming the currency we use for connected service convenience, and as we live through a new era of data analysis, the giving away of personal data is becoming increasingly normalised.

Convenience and value perception will be the main drivers for adoption.

The Heart of Our Future

ECG biometrics offers us greater security and safety in a world of risk protecting not just our devices, apps and data but even our physical selves.

Used in a multimodal approach, ECG authentication potentially offers us the most powerful digital security available in the current markets, and if the value of using internal biometric data as an authenticator can be communicated, we could be looking at a world where your heart is your key.

The extrapolation of insight from ECG-based data is arguably just as exciting as its authentication usage. Traditionally, this level of insight could only be obtained within a clinical setting.

Now we're looking at making this data available to everyone, every day, empowering people to manage their health and their lives.

Moving the dial on data analysis could help us redefine industries and build new markets, based on intense personalisation.

The race is now on to harness the disruptive potential of such data and be the first to benefit from this transformation.

B-Secur and partners are working hard to deliver the power of ECG biometric insights for wellness, authentication and more to everyone in the connected world.

Talk to us about partnership opportunities or to learn more about what we do

b-secur.com/contact

028 9080 2010