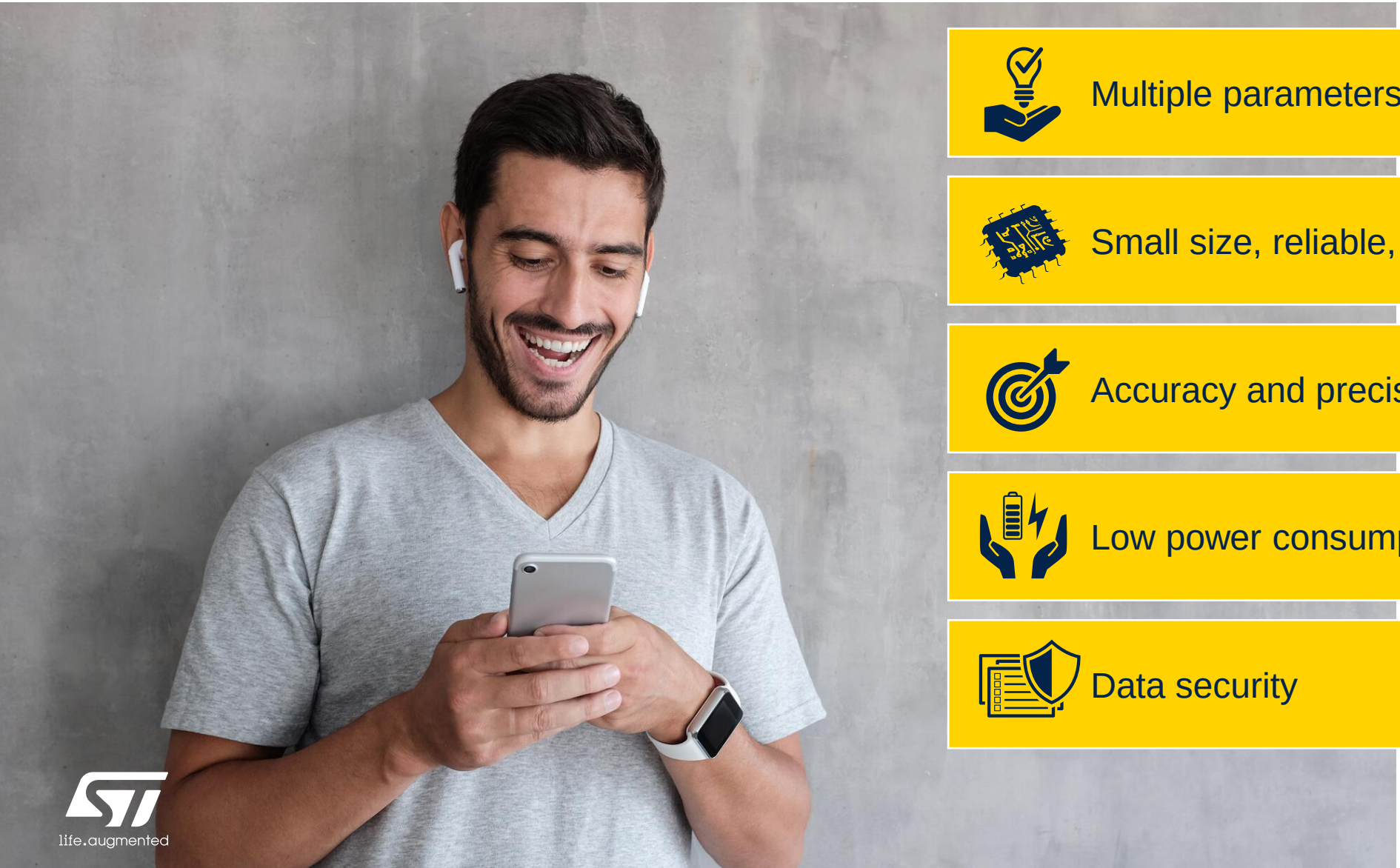
life.augmented

Biosensors for well-being and healthcare

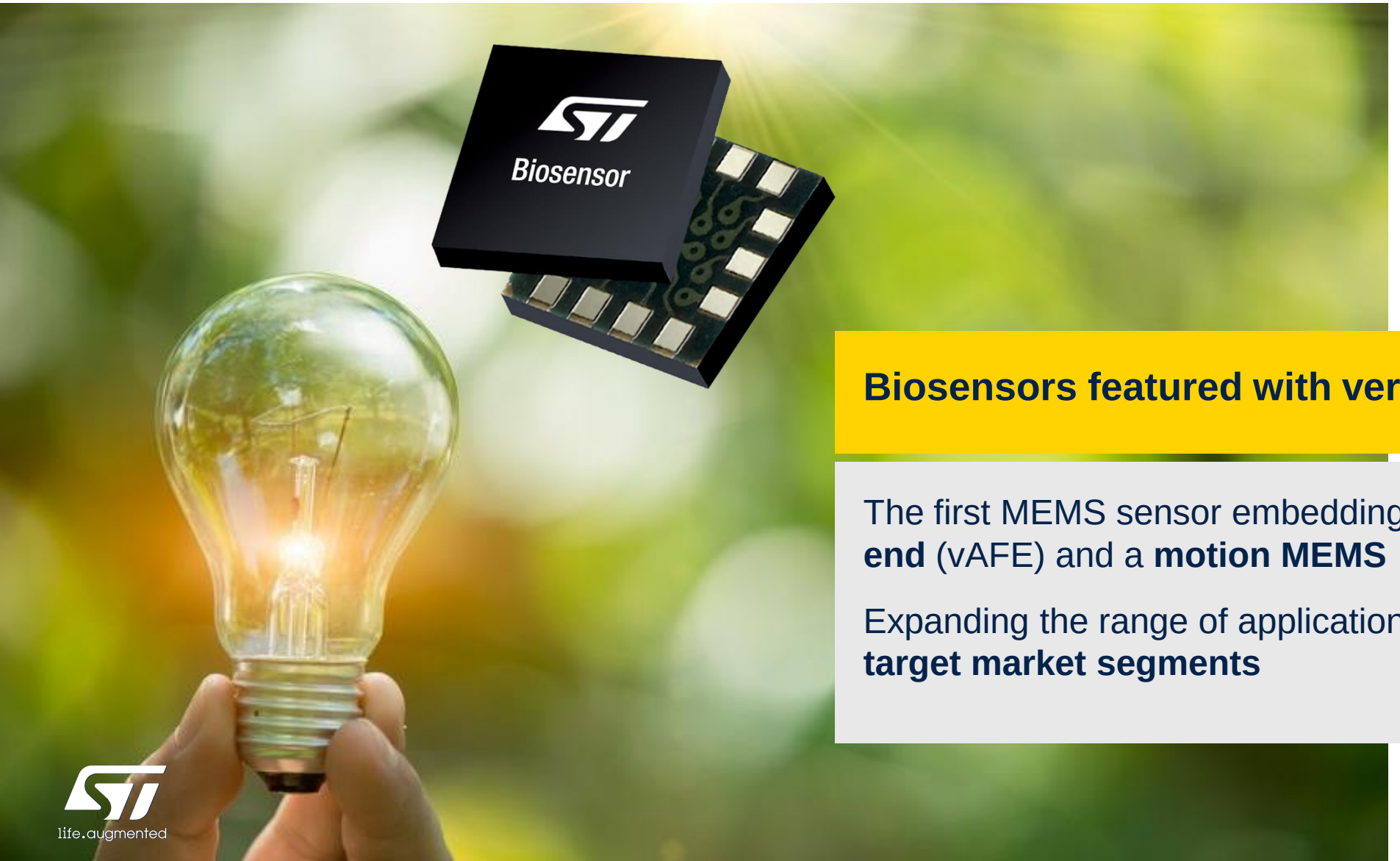
Challenges for sensors in well-being and healthcare



- Multiple parameters & non-invasive sensing
- Small size, reliable, and low cost
- Accuracy and precision
- Low power consumption
- Data security

life.augmented

A novel class of MEMS sensors
The biosensors



Biosensors featured with vertical analog front end

The first MEMS sensor embedding a **vertical analog front end** (vAFE) and a **motion MEMS**

Expanding the range of applications **beyond the usual target market segments**

life.augmented

Why a biosensor?

AFE performance

Power saving

BOM reduction

Enhance efficiency with ST biosensor

for **predictive healthcare** of the **human body**

Meaningful data

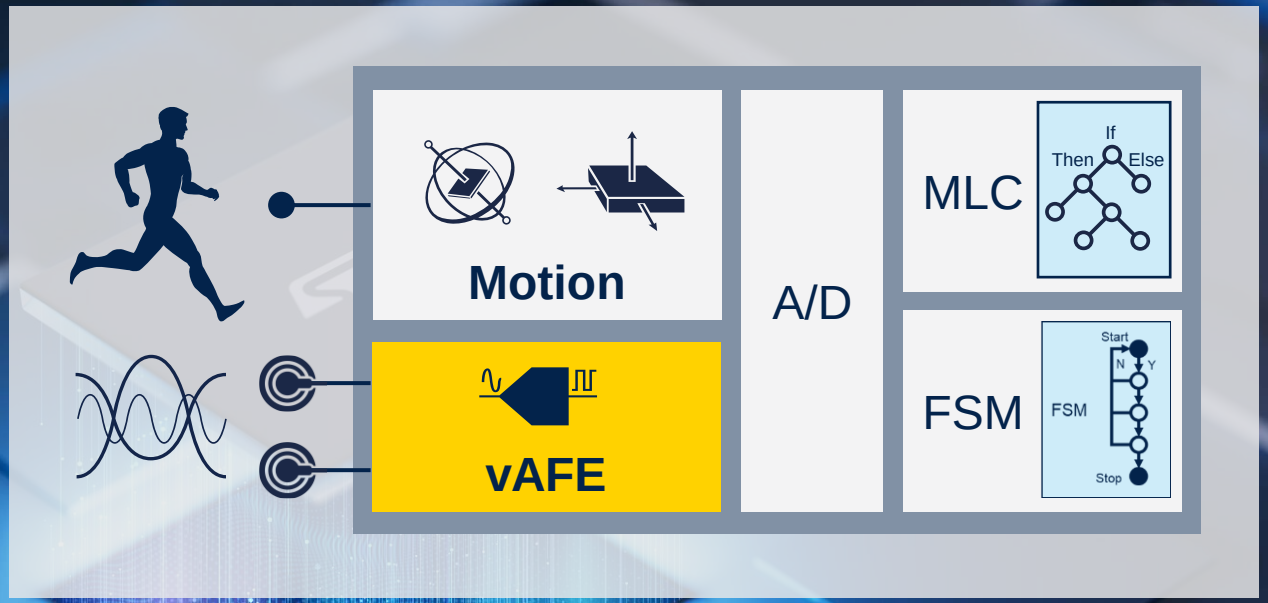
Bio signals based on situation

Bio signals triggered by events

life.augmented

Inside ST biosensors

A new sensor technology for digital healthcare and vital signs monitoring



vAFE, a specific analog circuit implemented into the MEMS sensor and capable to detect **bio-signals** through connected electrodes

Full synchronization of **analog** input channel with **motion** MEMS sensing channels.
Data available to **FSM*** and **MLC*** embedded resources

*FSM = finite state machine
*MLC = machine learning core

life.augmented

Comparison: vertical AFE vs general purpose AFE

vertical AFE

Enabling interaction with the external analog world for fitness and wellness, and medical applications

- Optimized for a dedicated task
- Unique blending of analog signals & motion information
- Embedded processing in MEMS sensor offloading the microcontroller
- Leverage MEMS sensor embedded ecosystem, including MLC
- Simple to use

Suitable for portable and wearable devices

VS

General purpose AFE

Standalone analog device for medical applications

- Multi-purpose applications
- Standalone device
- Need for an external microcontroller
- Complex to use
- Costly device

Suitable for medical devices and applications

life.augmented

Which attributes for biosensors?

Synchronization

Biopotential and **motion** signals are intrinsically **synchronous.**

Unique **context-aware analysis and artifact removal** with **in-sensor AI.**

Miniaturization

Integrates biopotential & motion information measurement system in a **compact form factor.**

Vital signs monitoring, healthcare, and gesture detection **in any wearable device.**

Efficiency

Ultralow power consumption: few µA to record and process information.

Analysis **at the edge**, leveraging in-sensor AI features, **offloading the microcontroller**

Enhance efficiency with ST dual-function biosensor that **monitors movement and bio signals**, paving the way for **predictive healthcare of the human body**

life.augmented

Human-centered biosensors in applications

- Electrocardiography (ECG)
- Electroneurography (ENG)
- Electroencephalography (EEG)
- Seismocardiography (SCG)

Smartwatch

Chest band

TWS

AR / VR

Headphone

Smart glasses

Smart ring

Helmet

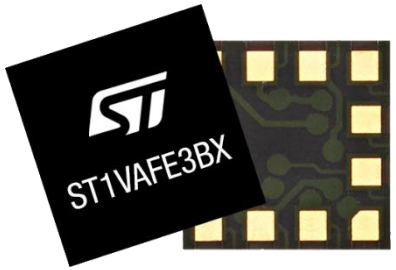
life.augmented

ST1VAFE3BX Biosensor

Embedding a low noise vAFE + ultralow power accelerometer

Product status

Mass market ready



LGA-12L
2.0 x 2.0 x 0.74 mm

Applications

- Heart monitoring
- Cognitive status
- Gesture recognition

- Ultralow power consumption — **~ 50 µA**
- Adjustable amplifier gain — **2x / 4x / 8x / 16x**
- Low input noise — **10 µV @ 20 Hz – 400 Hz (gain 16x)**
- Processing in the edge — **Embedded FSM, MLC & ASC**
- Ultralow power 3-axis smart accelerometer

life.augmented

ST1VAFE6AX Biosensor

Embedding a vAFE* + low power IMU

Product status

Mass market ready

LGA-14L
2.5 x 3.0 x 0.71 mm

Applications

- Heart Rate Monitoring (HRM)
- ECG & SCG

Low power vAFE — **15 µA on top of IMU consumption**

Configurable input impedance — **from 235 MΩ to 2.4 GΩ**

Wide input range — **±460 mV**

Processing in the edge — **Embedded FSM, MLC & ASC, SFLP**

Low power, low noise 6x IMU

(*) Pre-amplification needed for low level biopotential signals

life.augmented

Biosensors for heart analysis and monitoring (ECG)

Healthy status indicators can be derived by ECG measurements

User healthy classification based on ECG

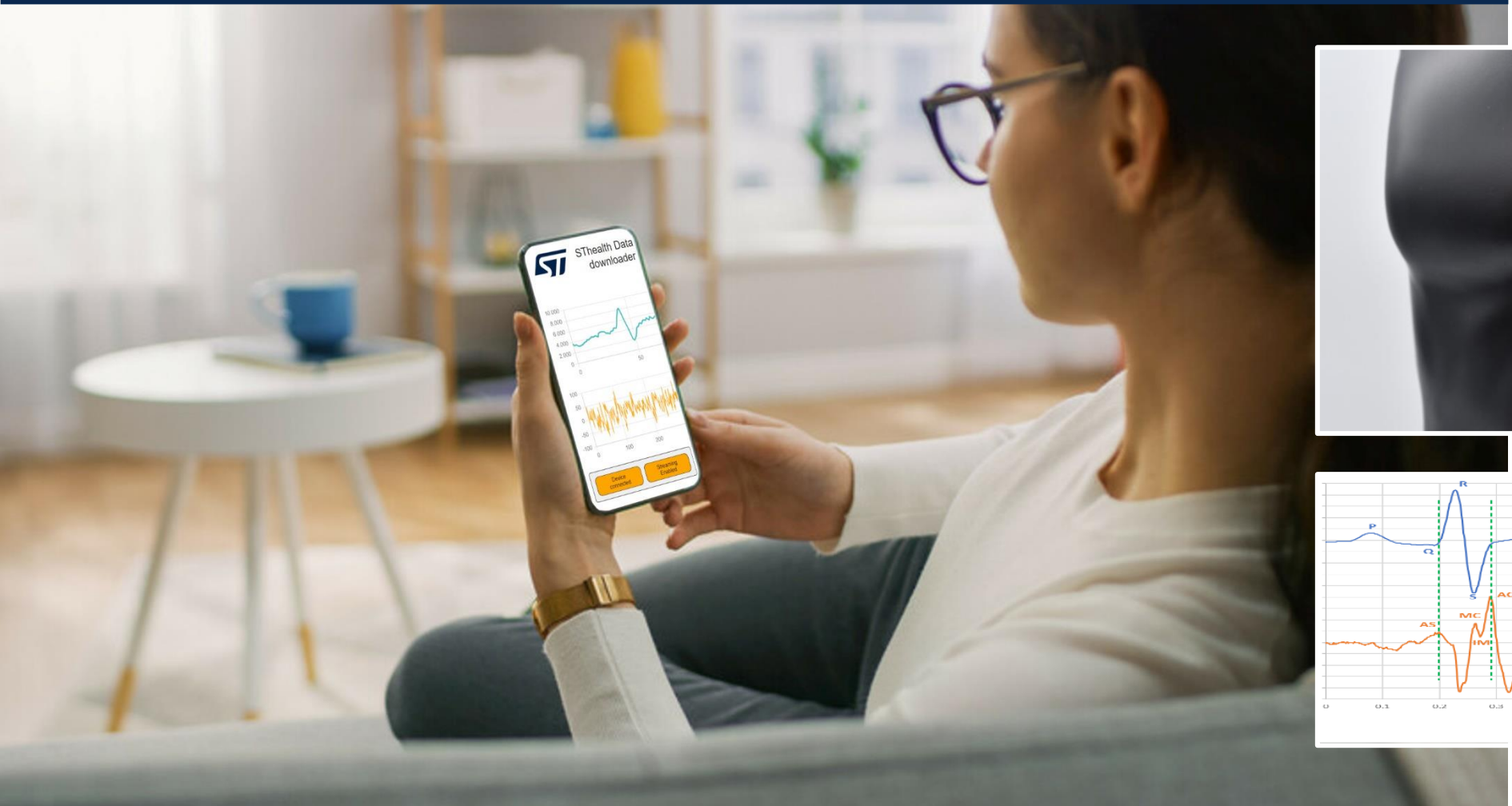
ECG interpretation based on user activity

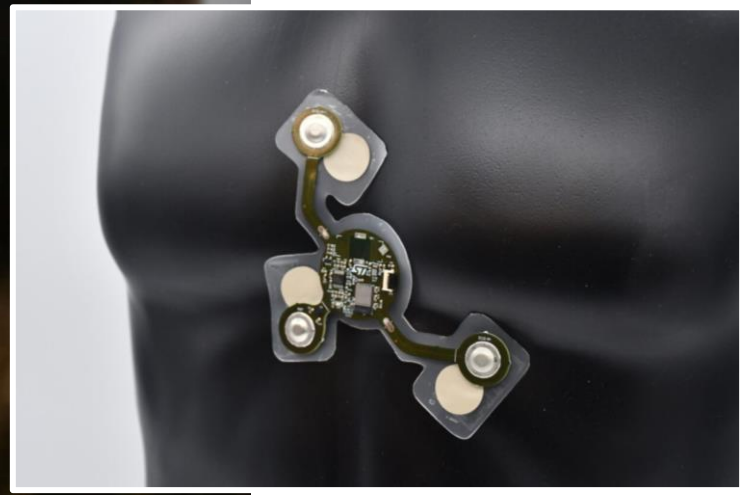
ECG is used for triggering other measurements

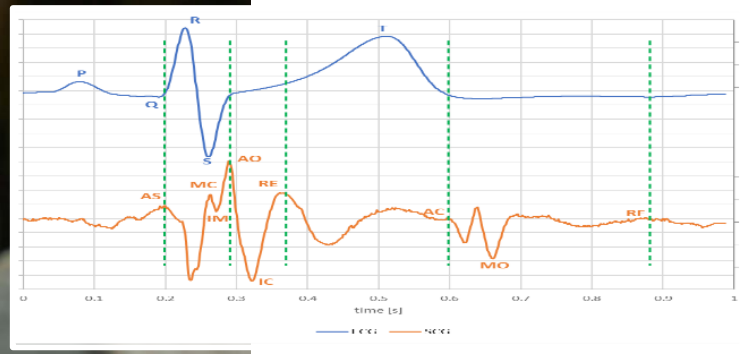
life.augmented

Biosensing platform for cardio monitoring (ECG & SCG)

ST & DuPont reference design platform for intelligent and context-aware electrocardiography and seismocardiography





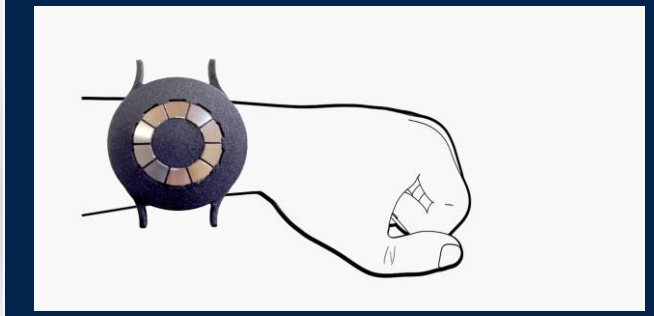


Biosensor for electroneurography (ENG)

Introducing the next generation of user interface experience

Biosensor and patented **electroneurography** (**ENG**) techniques by Pison to create a touchless, gesture-based HMI

In addition to gesture recognition, **cognitive readiness and mental agility** can be evaluated through ENG signal



Any smartwatch or wearable can be infused with the power of biosensor giving users virtually unlimited and effortless command of their environments

life.augmented | PISON

Biosensor for electroencephalography (EEG)

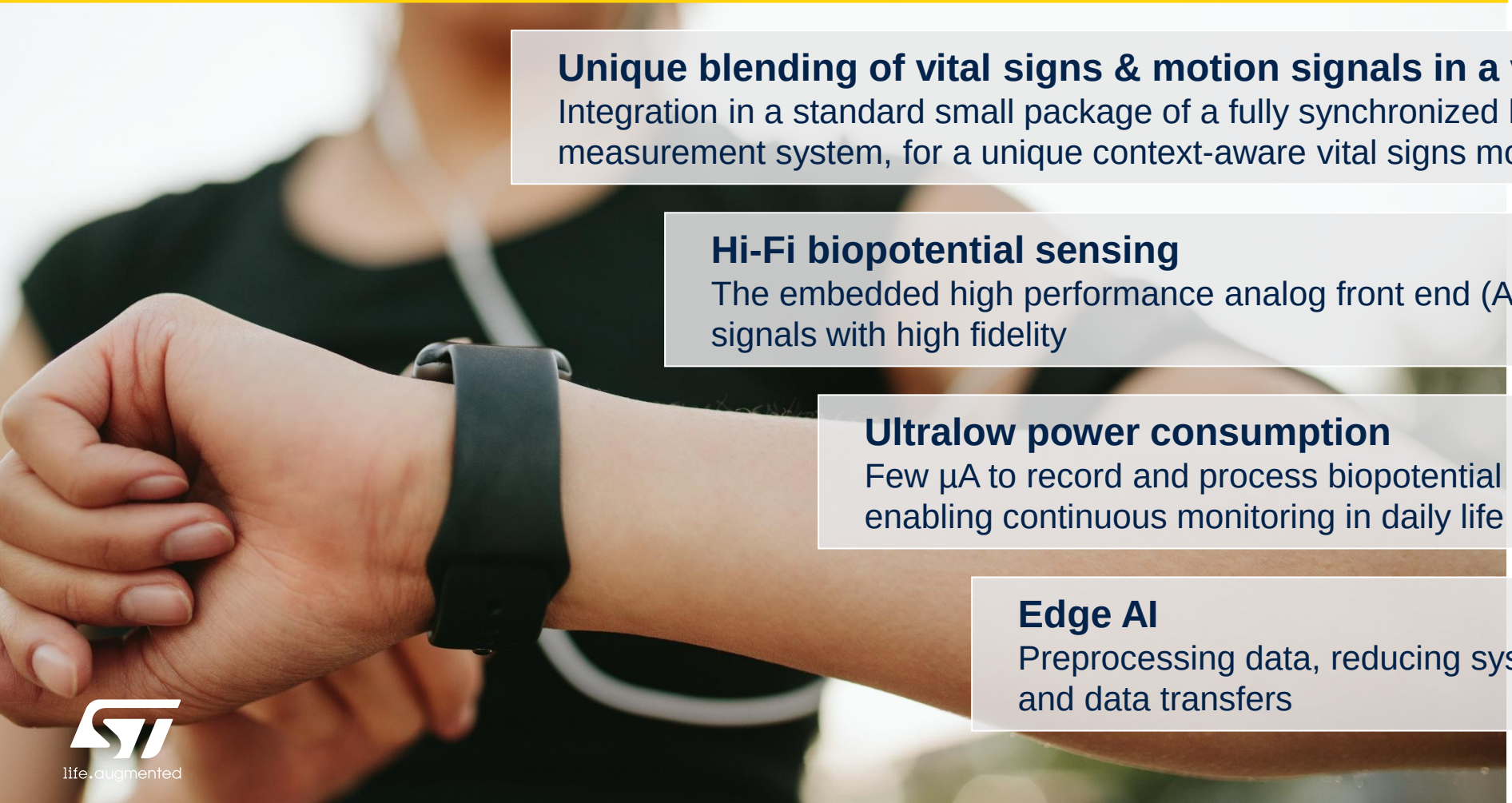
Real-time, accurate, cognitive, and emotional information, using wearable devices and sensors

- Mental healthcare and wellness
- Real-time emotional response
- Attention and cognitive status

life.augmented

ST’s biosensors: the breakthrough for digital health

Biosensor’s key benefits



Unique blending of vital signs & motion signals in a very compact form-factor
Integration in a standard small package of a fully synchronized biopotential & motion information measurement system, for a unique context-aware vital signs monitoring in any wearable device

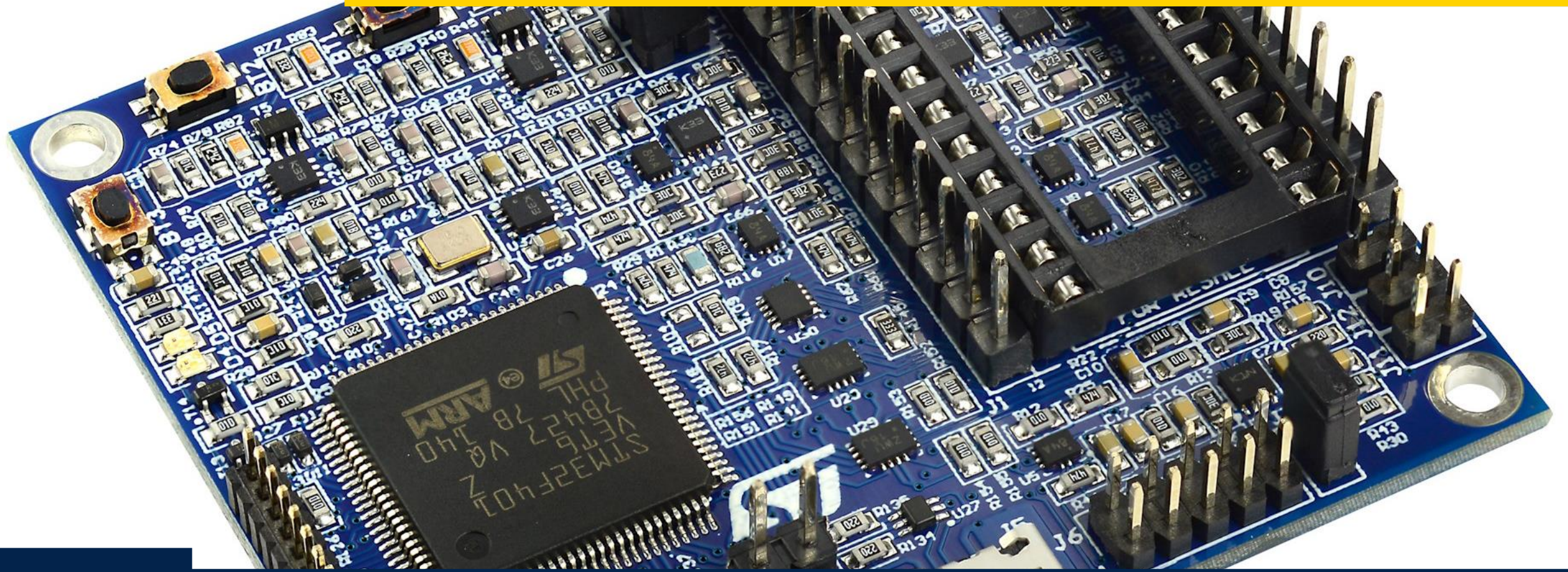
Hi-Fi biopotential sensing
The embedded high performance analog front end (AFE) measures the weakest body signals with high fidelity

Ultralow power consumption
Few µA to record and process biopotential signals & motion information enabling continuous monitoring in daily life

Edge AI
Preprocessing data, reducing system-level power consumption and data transfers

life.augmented

MEMS ecosystem offer for biosensors



life.augmented

ST ecosystem supporting learning and prototyping for biosensors

Biosensor's ecosystem deliverables for a ready-to-go solution

Hardware

- Professional MEMS tool
- DIL24 adapter boards

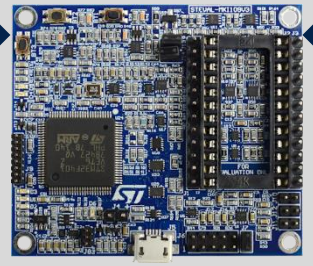
Application example

- ECG & HBR by chest
- ECG & HBR by fingers

Development tools

- MEMS Studio & BIO_VSM library

Professional MEMS tool
(STEVAL-MKI109V3 or STEVAL-MKI109D)



ECG through chest

Custom adapter for chest leads (3.5 jack connection)

ST1VAFE6AX	ST1VAFE3BX
STEVAL-MKI242A (jack connection)	STEVAL-MKI250KA (kit for both jack connection and fingers)
STEVAL-MKI249KA (for fingers)	

ECG through fingers

Additional adapters for fingers electrodes (direct fingers contact)

life.augmented

Our technology starts with You

Find out more at st.com/biosensors

life.augmented