RUTRONIK EMBEDDED

TechTalk

BOSCH

Self-learning AI Sensor BHI260AP for Fitness Tracking

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Self-learning AI sensor BHI260AP:
World’s first self-learning AI sensor for wearables and hearables with unique self-learning and personalization features

Self-learning AI sensor BHI260AP
Agenda

1. Introduction to BHI260AP
2. Self-learning AI software
3. Swimming software
4. PDR software
5. Q&A

Smart sensor systems
Bosch Sensortec portfolio

Motion sensors	Environmental sensors	Smart sensor systems	Optical microsystems
Absolute orientation sensor (BMX)	**Gas sensor** (BME)	**AI sensor systems** (BHI260AP)	**Smartglasses Light Drive** (BML)
Inertial measurement unit (BMI)	**Humidity sensor** (BME)	**Programmable sensor systems** (BHI, BHA)	
Accelerometer (BMA) **Gyroscope** (BMG) **Magnetometer** (BMM)	**Barometric pressure sensor** (BMP)	**Sensor nodes** (BNO, BMF)	

Software & tools, embedded algorithms and AI solutions

Self-learning AI sensor BHI260AP
Software

System power

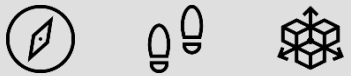
- In-sensor features
  - Step count
  - (Wrist)Wake-up
  - Multi-tap
  - Activity status
- PDR+GPS fusion

Unique features

- Activity tracking
  - Automatic
  - Extensible
  - Personalized
  - Self-learning

Scalability

- Standalone modules
- Flexibility in product specific choices
  - Performance vs. power
  - Features vs. size



Data quality

- In-use calibration
- Distortion detection
- Multi-sensor fusion

SELF-LEARNING AI SOFTWARE

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BHI260AP: Self-learning AI software
Challenges in fitness tracking

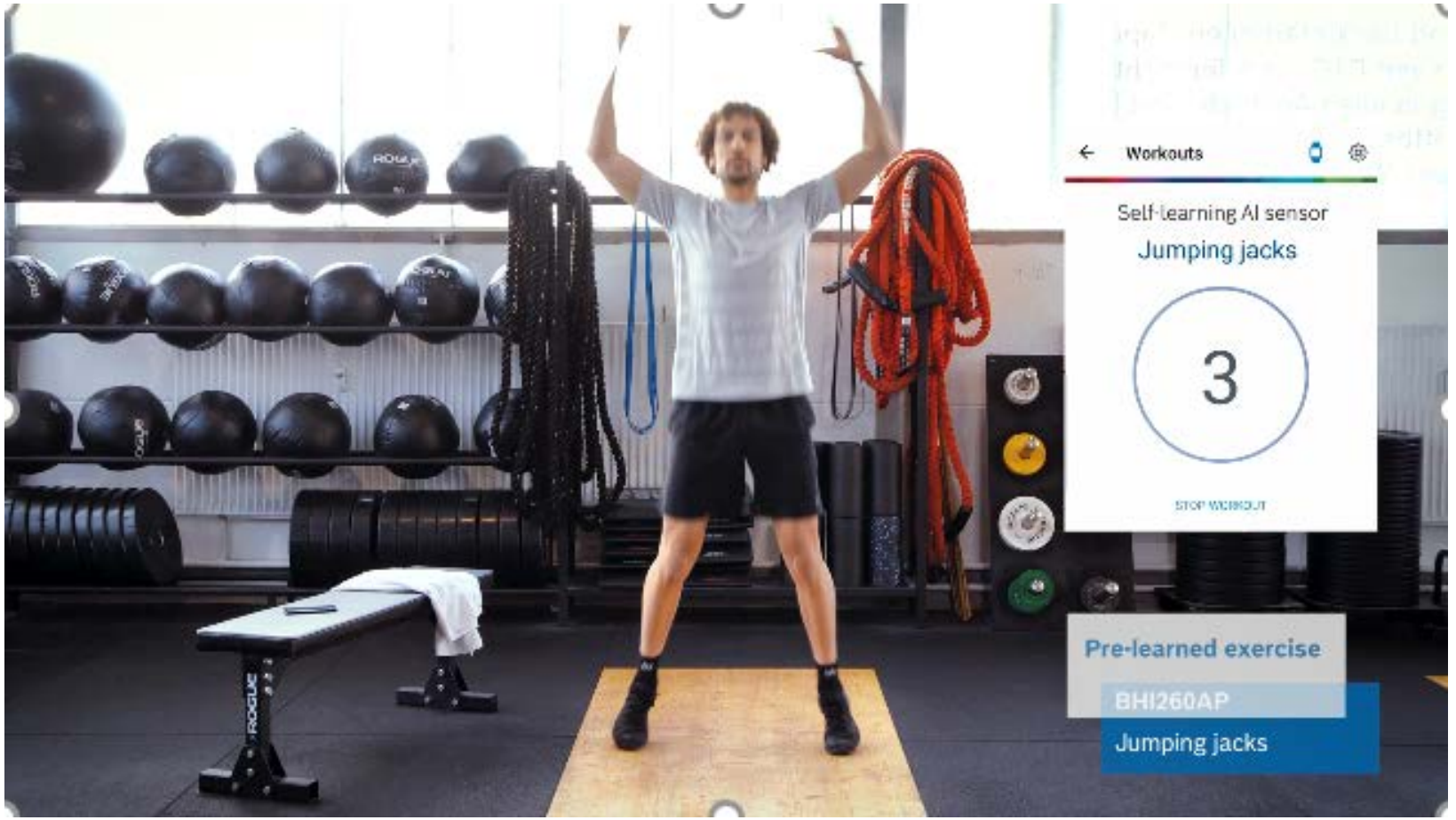
Multiple activities

Limited time of coach

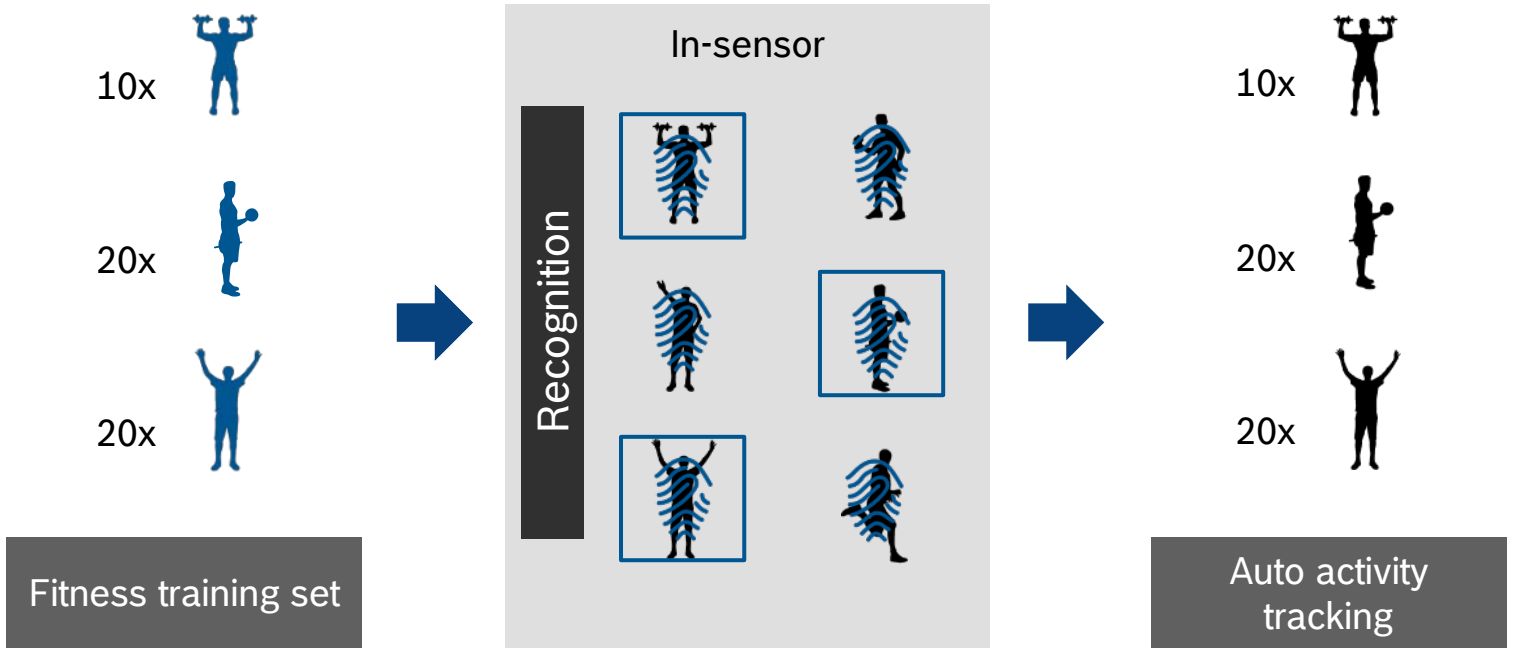
Manual tracking

Classical tracking systems fail: Variety of machines and body activities, home workouts, switching among activities, demographics and individual user energy levels

BHI260AP: Self-learning AI software
Personalized fitness tracking

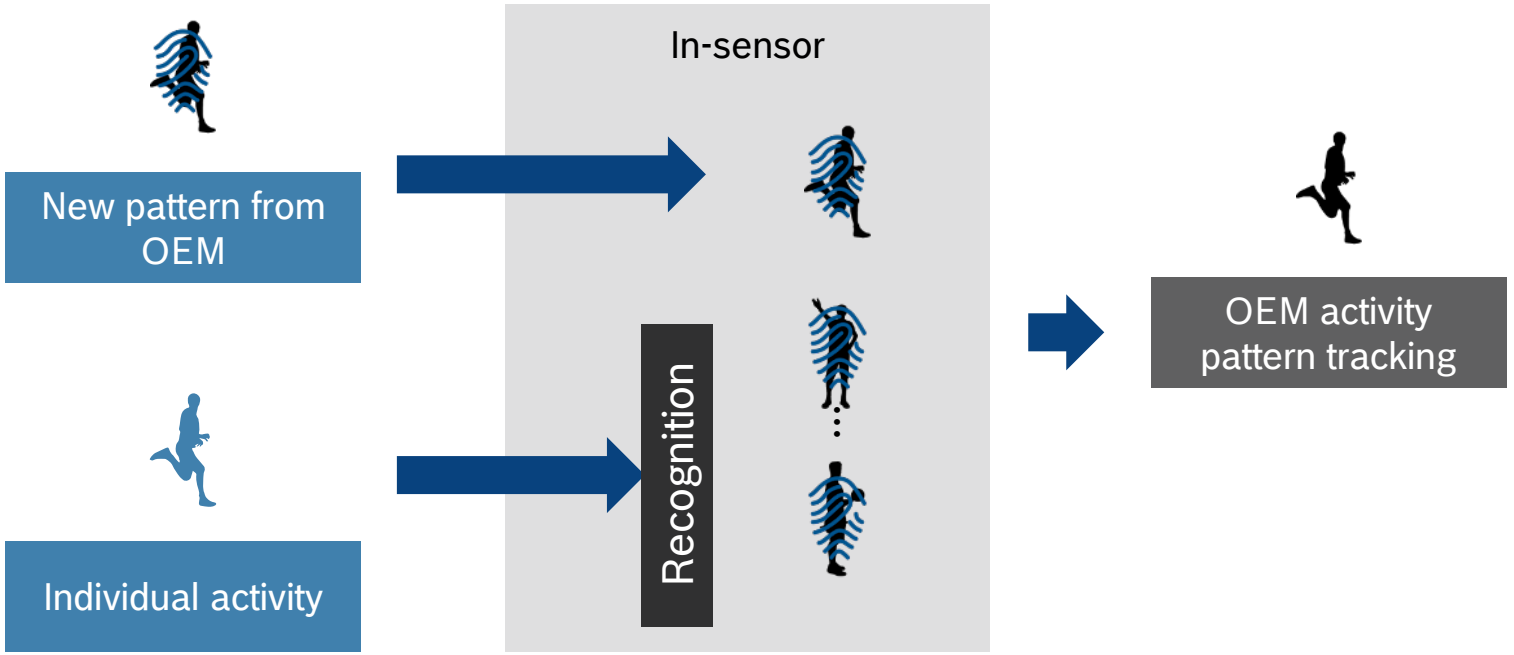


BHI260AP: Self-learning AI software
[1/4] Automatic tracking



- Bosch Sensortec provides automatic detection for 15+ common activities based on sample data
- Automatic tracking works seamlessly even for new OEM patterns without modifying software

BHI260AP: Self-learning AI software
[2/4] Add new activities by OEM



- OEMs can also enhance / add new activities
- No need to modify the software to enhance the device value

Personalized fitness tracking

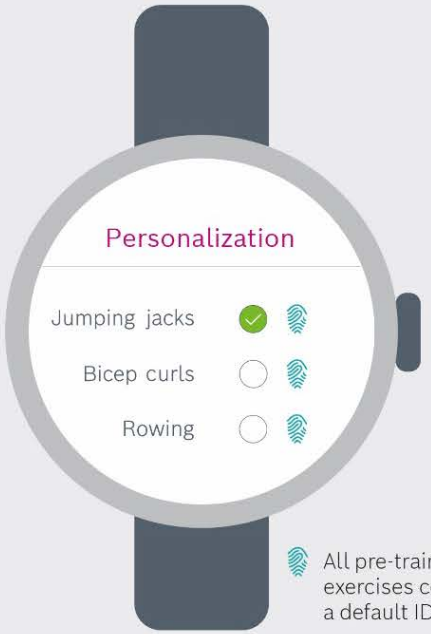
BHI260AP

With the BHI260AP it is possible to adapt pre-learnt activities to an individual style and to analyze progress over time.

BHI260AP: Self-learning AI software

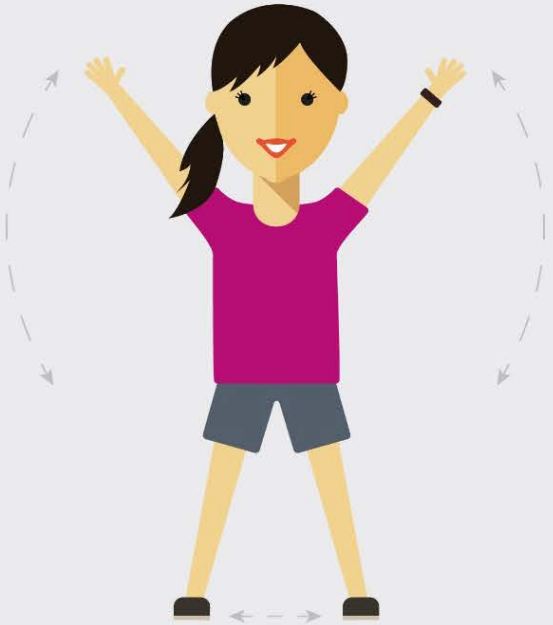
Personalizing exercises

Select one of the existing fitness activities that you want to personalize:

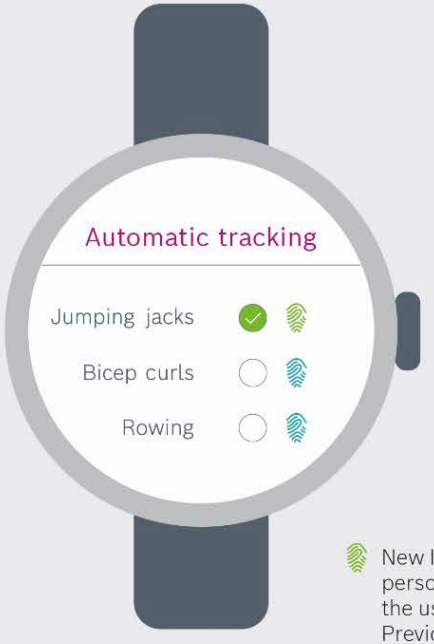


All pre-trained exercises come with a default ID.

Train your device by performing the exercise in your own style:



The sensor **recognizes** your style and generates an individual ID:



New ID is personalized for the user. Previous ID can be stored or replaced.

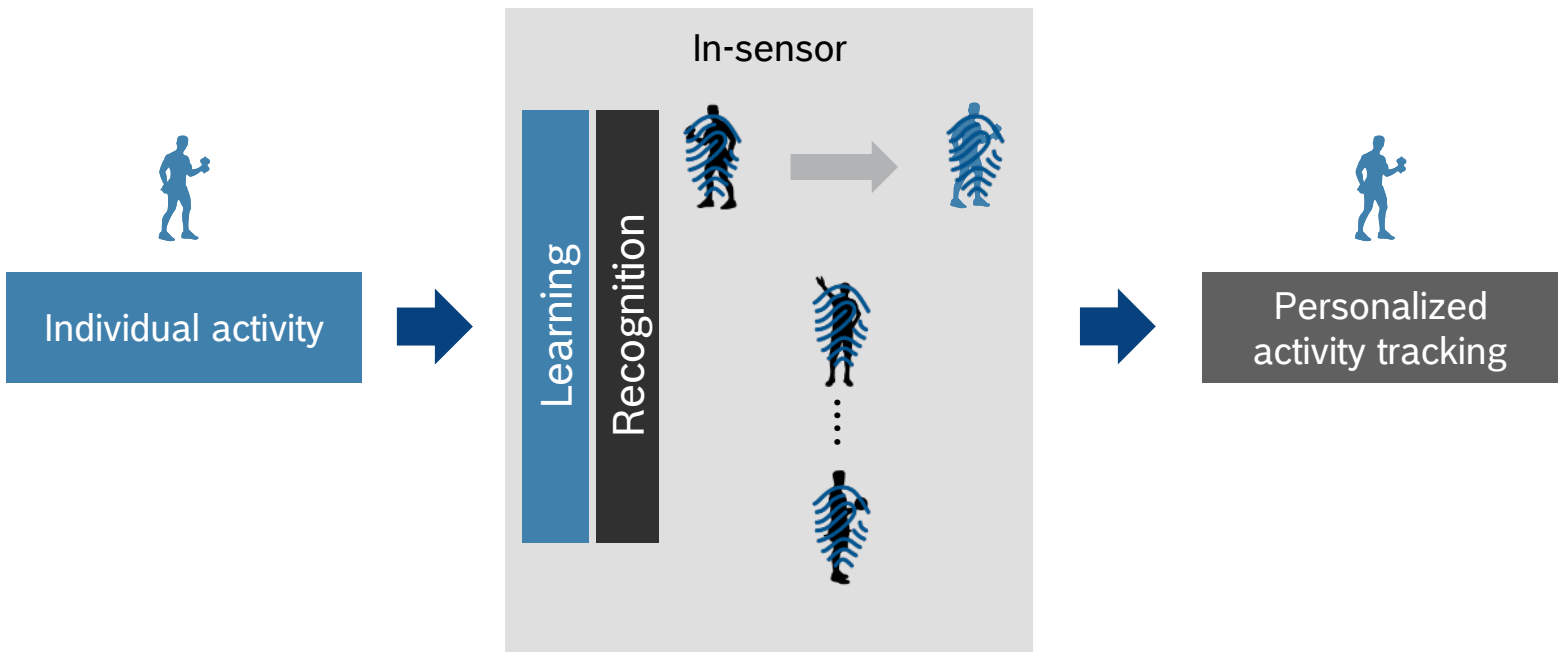
Benefits of personalizing fitness exercises:

Personalization improves the detection of an activity and the accuracy of counting.

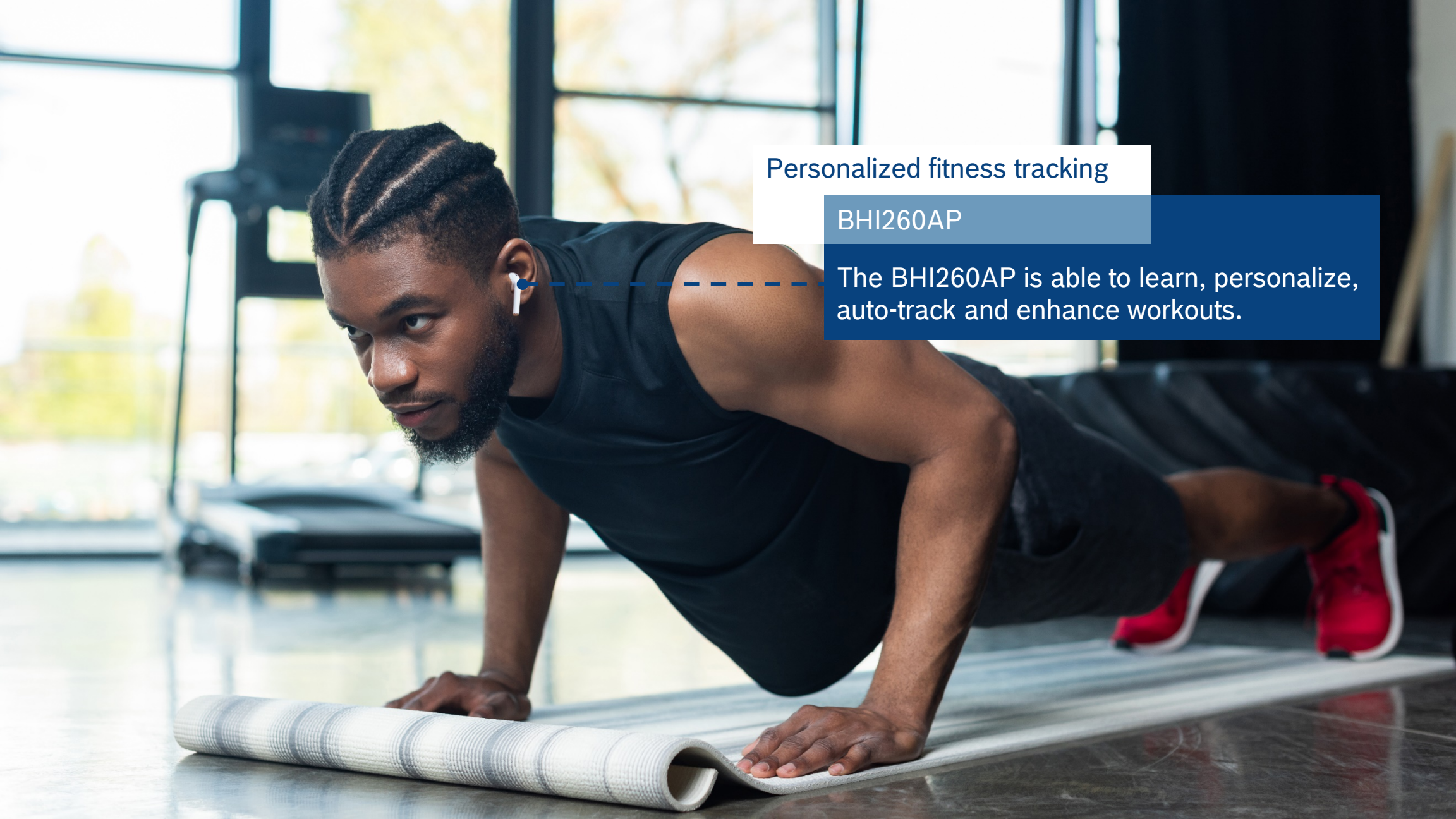
On-device personalization helps to keep user's data private.

On-device personalization helps to optimize the personal training performance.

BHI260AP: Self-learning AI software
[3/4] Personalized automatic tracking



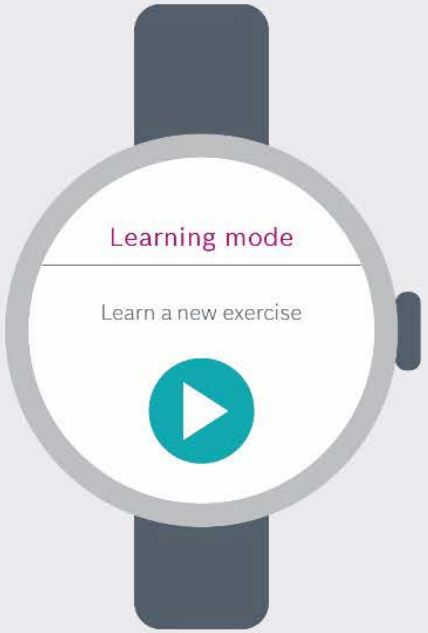
- Users can personalize built-in activities to match their own style without changing the software
- Sensor API enables users to relearn & replace activities directly from the device
- Bosch Sensortec provides reference code / App to help enable personalization


Personalized fitness tracking
BHI260AP
The BHI260AP is able to learn, personalize, auto-track and enhance workouts.

BHI260AP: Self-learning AI software

Learning new exercises

Start the learning mode to add exercises that are not yet supported:



Record the exercise that you would like to add by performing it:

The recording takes only about 30 seconds!

Name your exercise to have it added to your list. The exercise is learnt.

An ID is assigned to the new exercise to identify it when performing the next workout.

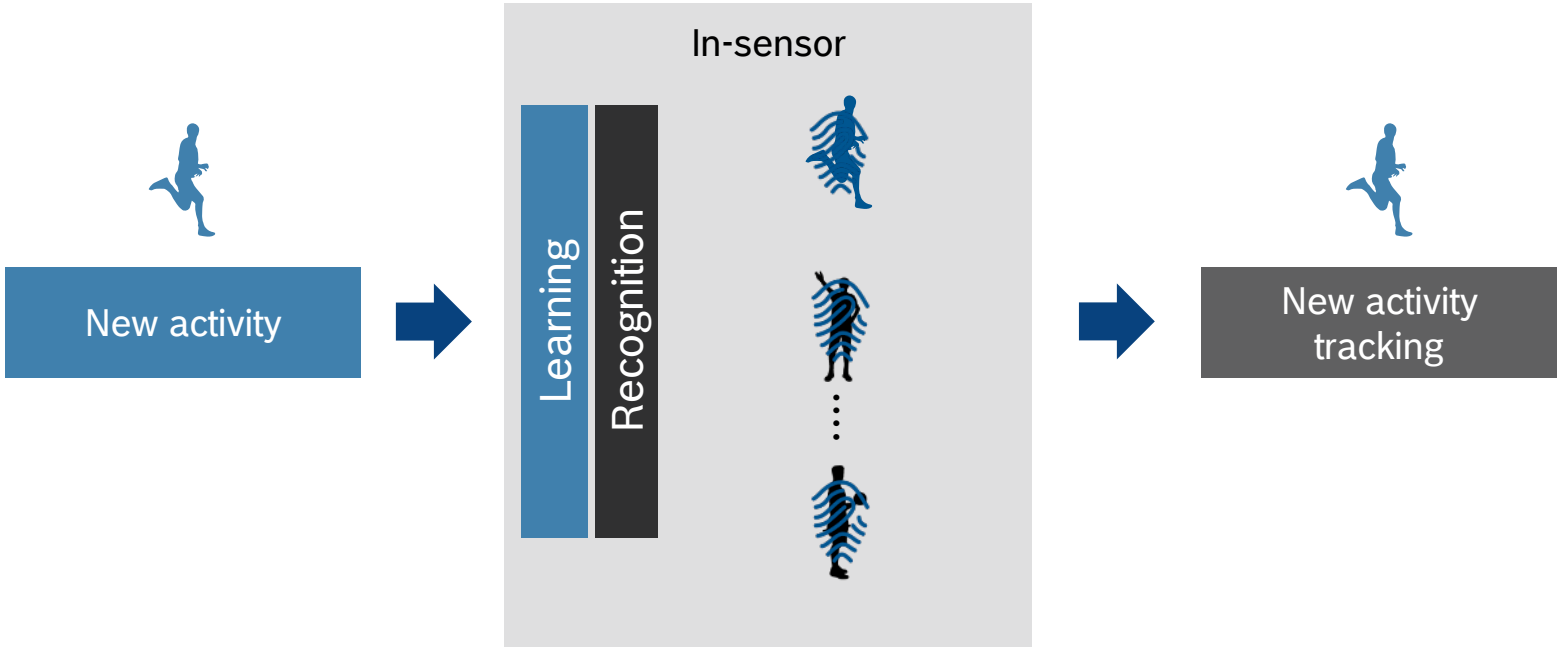
Benefits of learning new fitness exercises:

Learning new exercises enables users to customize the devices to their individual workouts.

On-device personalization helps to keep user's data private.

On-device learning helps to optimize the personal training performance.

BHI260AP: Self-learning AI software
[4/4] Learn new activities from user



- Users can add new activities within < 30 seconds
- Learning and recognition can be enabled / disabled dynamically by OEMs with sensor API

BHI260AP: Self-learning AI software
Glimpse of automatically tracked activities

Tricep extension

Bicep curl

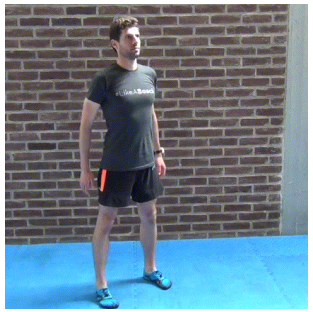
Palm face

Bench press

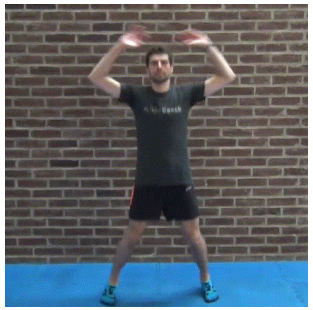
Chest fly

Pull over

Side lateral raise



Squats



Jumping jacks

Russian twist

Kettle bell swing

Row machine

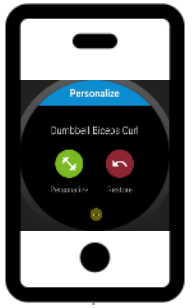
BHI260AP: Self-learning AI software
Evaluation system

Reference software

- Visualization via Android App
- BLE: Streaming, load firmware

BHI260AP

- Learning of new exercises
- Personalization & recognition of pre-trained exercises



Smartphone App

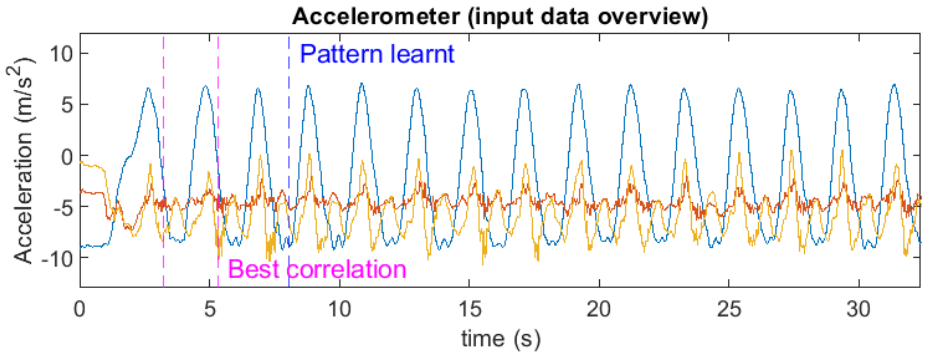
BHI260AP inside fitness trackers / bands

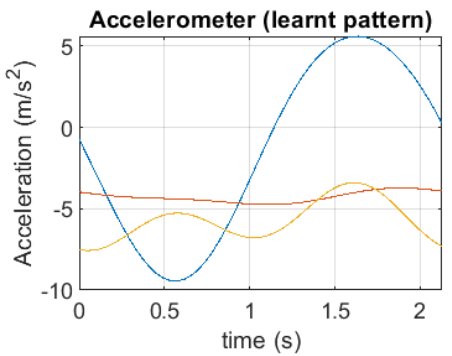
Watch App

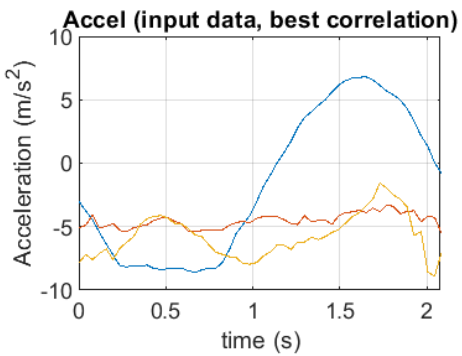
BHI260AP inside smartwatches

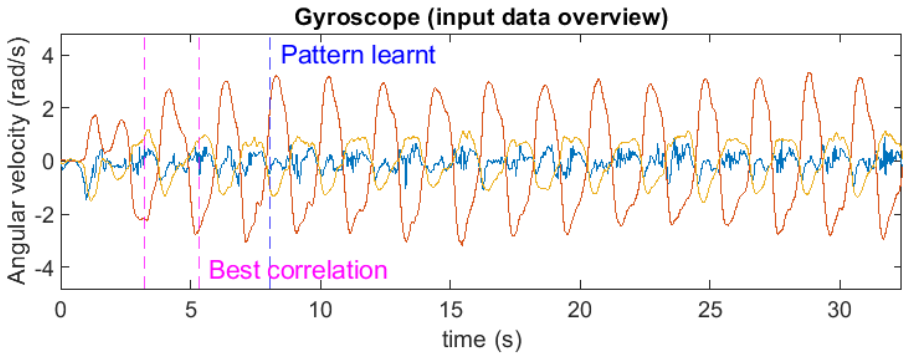
BHI260AP: Self-learning AI software

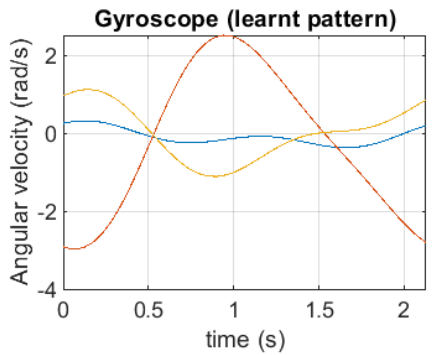
Automatic pattern visualization & custom configuration

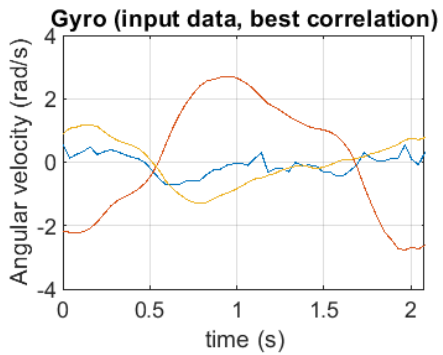










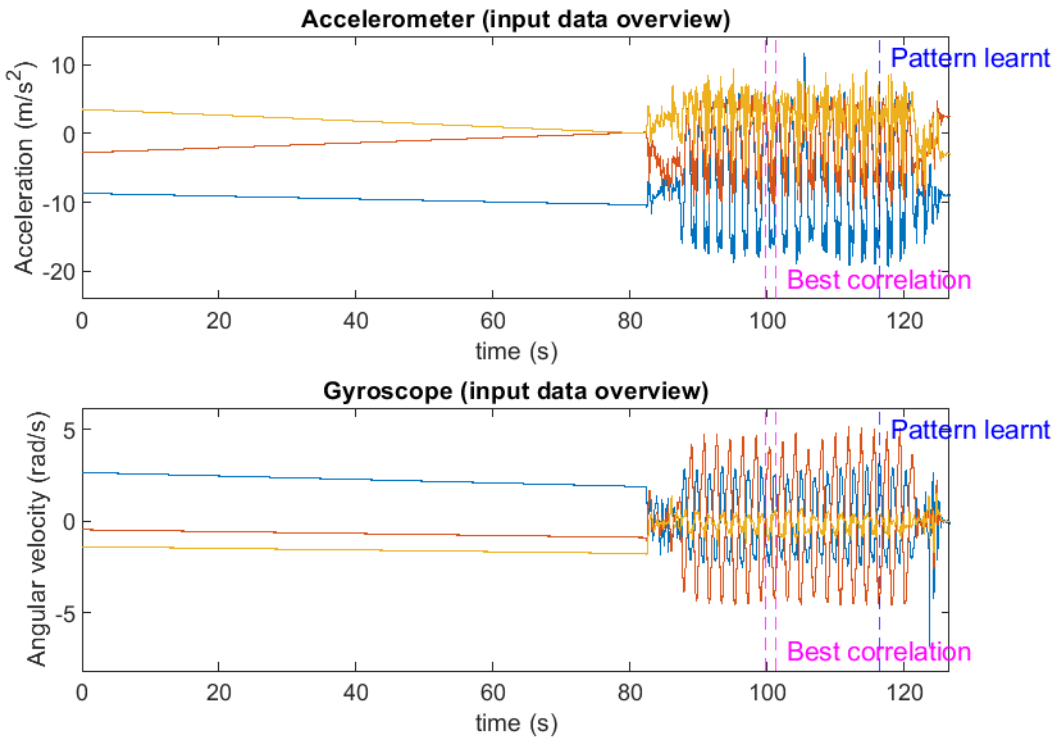


"White-box" system - device designers can visualize, configure and generate patterns according to their own needs

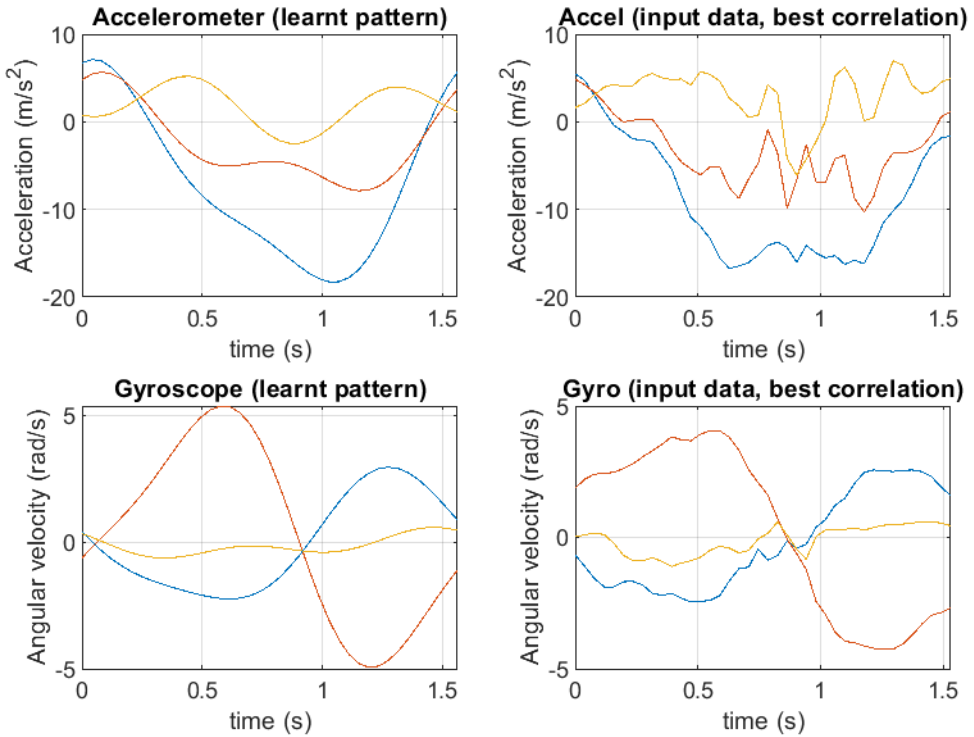
BHI260AP: Self-learning AI software

Support for pattern generation even with poorly labelled data

Input file D-Kettlebell-Swi... overview



Learnt pattern for D-Kettlebell-Swi... (0.64 Hz, showing 1 rep(s))



Self-learning AI software selects “relevant” data automatically and generates patterns with best correlation among multiple input files

BHI260AP: Self-learning AI software
Summary: Key facts

Key performance factors		Bosch Sensortec self-learning AI software
Functionality **End-user experience**	Learning (new activities)	Learning inside device → enables learning new activities from users
	Personalization of tracking	Learning inside device → enables full personalization to a user
	Tracking: number of activities	Large number of activities (typ. 10~50) tracked simultaneously
	Tracking: status / count	Both activity status and count for all activities
	In-field customization / enhancement	OEMs can also add new activities just by adding new patterns without changing the software
Design **Time to market**	Data labelling	No need of labelling individual activity signals. Patterns are generated based on larger datasets with a cloud based simulator
	ML / AI and statistics	No need of manual selection and implementation of statistical features
	Design time customization	OEMs can customize and configure both patterns and software with a cloud based simulator during design

Self-learning AI sensor delivers a ***truly personalized experience*** with state-of-the-art edge-AI

BHI260AP: SWIMMING SOFTWARE

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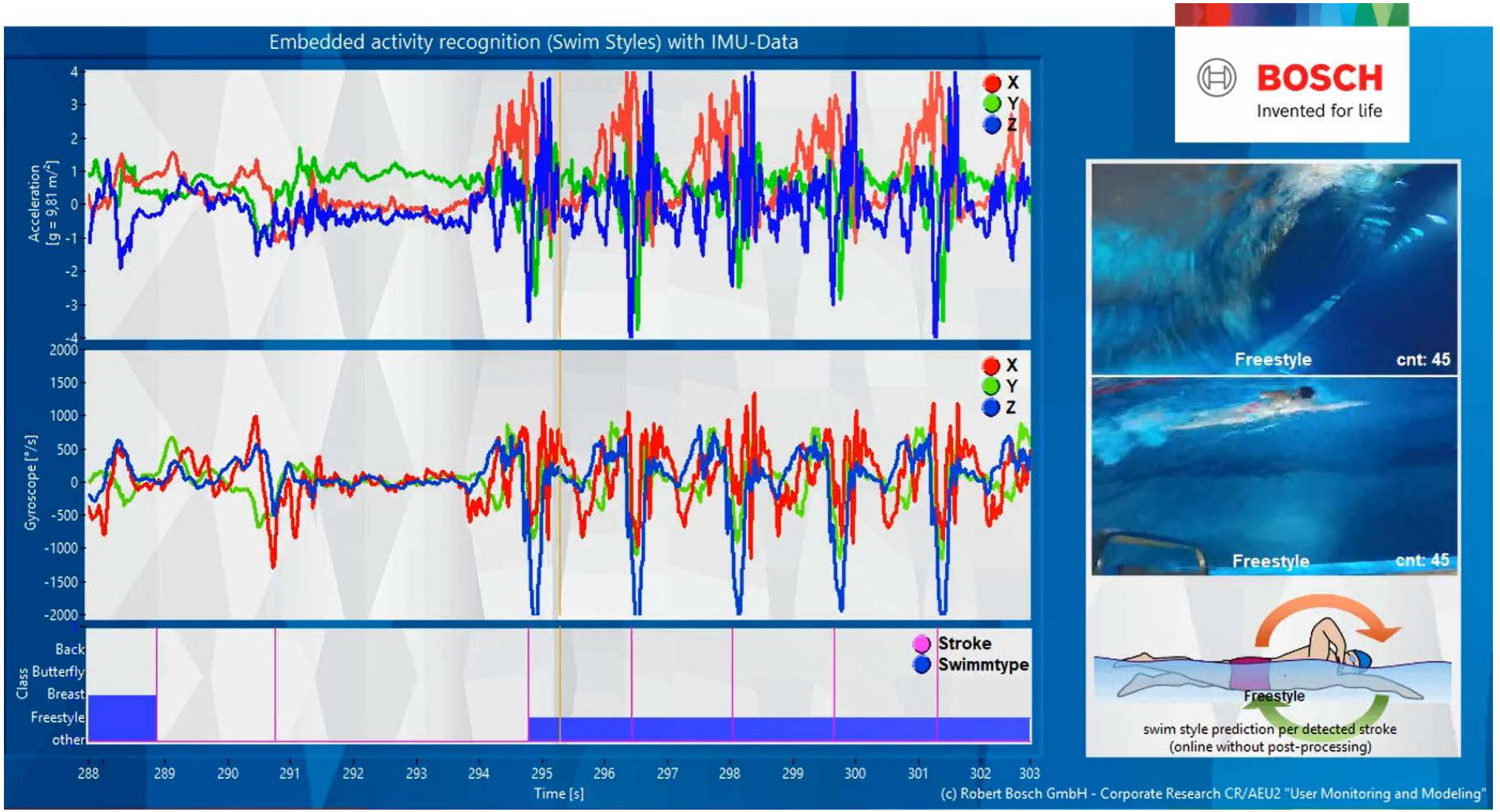
Accurate swim analytics

BHI260AP

The swimming software inside BHI260AP enables the recognition and analytics of lap count, stroke count and swim style.

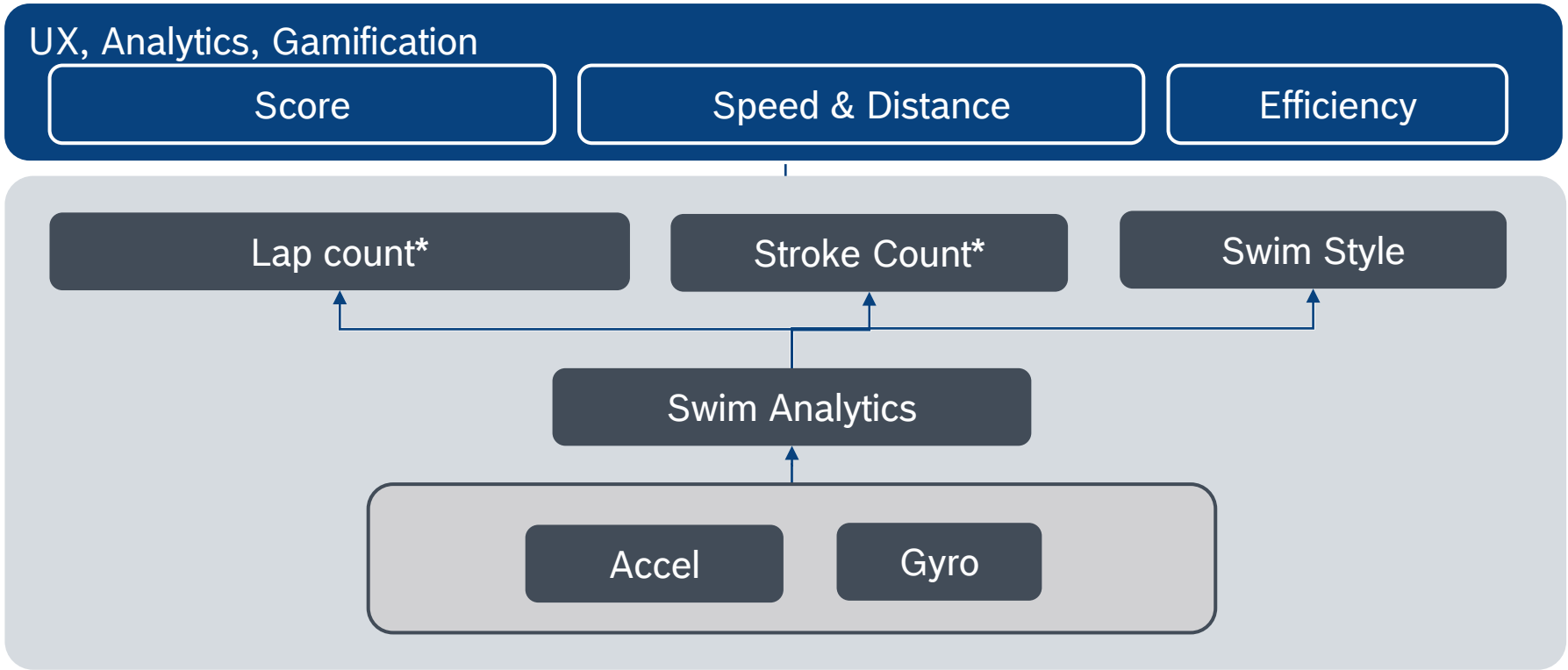
BHI260AP: Swimming software



BHI260AP: Swimming software
Swimming analytics

OEM/ODM

Bosch Sensortec



* Feature available with accel-only or IMU (A+G).
Recommended to use with IMU

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BHI260AP:
PDR SOFTWARE

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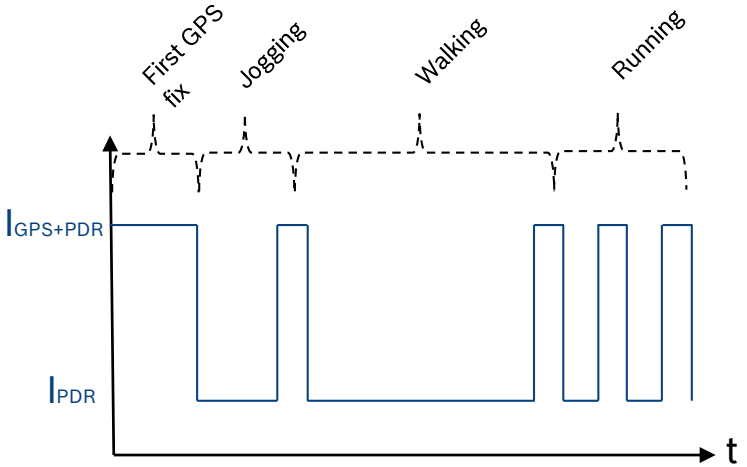
Accurate position tracking
despite weak GPS signal

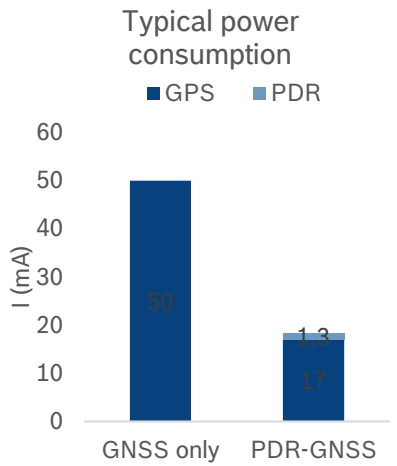

BAR
PEACE
GPS lost
Position tracking
active

BHI260AP: PDR software
Pedestrian Dead Reckoning

Solution: GPS + smart sensors

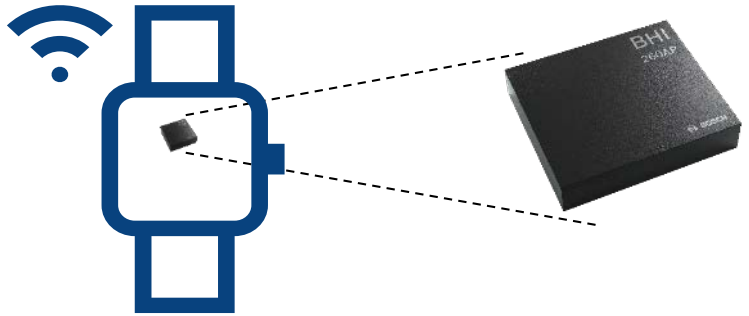
- Smart sensors calculate the user's relative location based on inertial data
- Re-calibrate every few minutes to obtain the absolute position provided by the GPS module





Benefit:

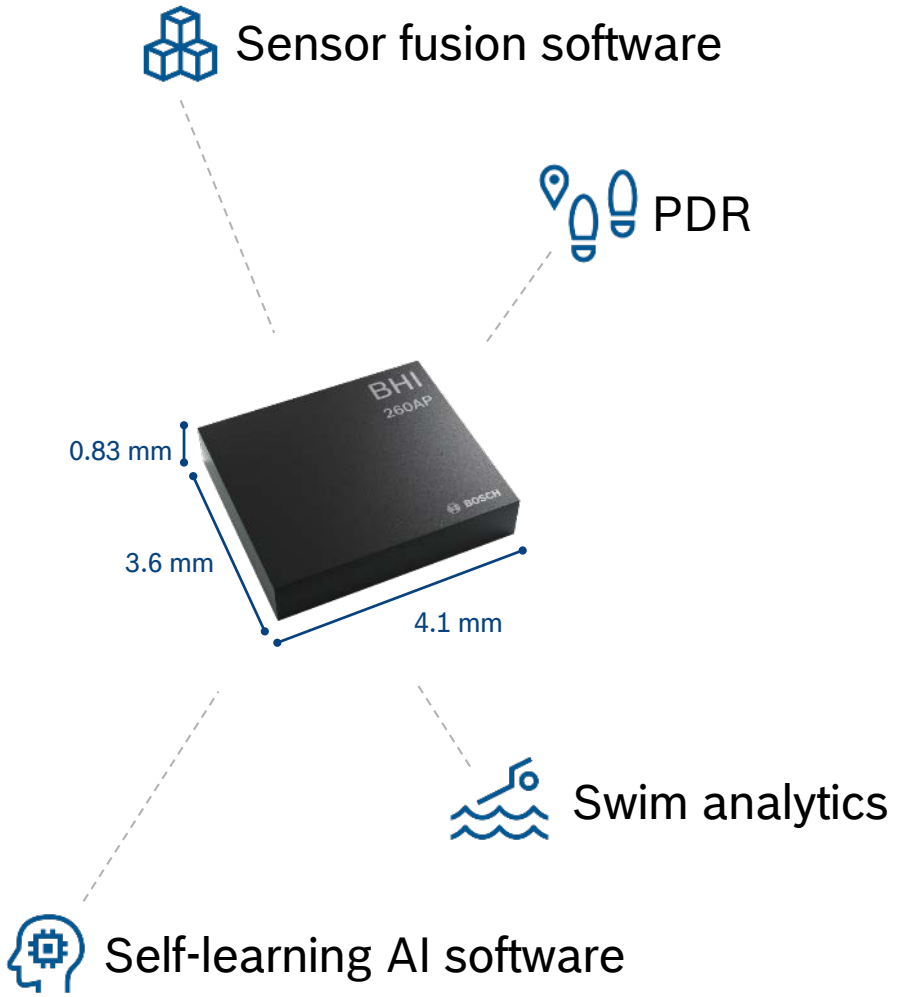
- Saving up to 80% battery as GPS can be kept in sleep mode
- More stable navigation as Smart sensors compensate lost GPS signal: enabling always-on position tracking



2 to 5 times longer GPS tracking while keeping a good position accuracy and improving the accuracy robustness

BHI260AP
Multi-purpose sensor

	2nd Gen	1st Gen		
Product Software	**BHI260AP (Pro)**	**BHI260AB (Basis)**	**BHI160BP (PDR1)**	**BHI160B (Basis)**
Sensor fusion	✓	✓	✓	✓
PDR	✓		✓	
Swim Analytics	✓			
Self-learning AI – Fitness tracking	✓			



THANK YOU

Q&A