

Me, myself and AI

How the new self-learning AI sensor personalizes your home workout

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Fitness tracking is presently experiencing a huge upswing in popularity. The market for fitness trackers and step counters has surged by 65% year-on-year¹, with just the Fitbit platform alone claiming nearly 30 million active users². Current activity tracking devices have demonstrated the huge market potential of this segment and have laid the groundwork for next-generation AI-enabled devices to take centre stage as individual fitness tracking goes mainstream.

The year 2020 was defined by the COVID-19 pandemic, which accelerated many developments in the area of decentralized lifestyles, from the home office boom to infection tracing solutions. One of the hardest-hit segments was gyms and fitness centers, where the risk of infection was deemed too high for them to remain open. This unpredictable change effectively created massive demand for intelligent home-based fitness solutions. Fitness enthusiasts needed to change how they exercised and had to adapt to social-distancing and other public safety measures by exercising at home. While running and walking have registered an upsurge in popularity during warmer temperatures, high intensity interval training (HIIT) at home, a very affordable system that uses short, intense physical activity at intervals, combined with quick breaks, has seen a substantial uptick in popularity.

¹ Source: Canalys, <https://www.zdnet.com/article/demand-for-smartwatches-and-fitness-trackers-is-exploding-so-why-isnt-fitbit-doing-so-well/>

² Source: <https://investor.fitbit.com/press/press-releases/press-release-details/2020/Fitbit-Reports-2019-Fourth-Quarter-and-Full-Year-Results/default.aspx>

For fitness trackers and smartwatches this shift in demand to home-based "trainerless" solutions offers substantial potential to benefit users by accurately informing and assisting them with their solo exercise programs. This, however, is no simple task, since the scope and variation of activities that need to be analyzed grows by orders of magnitude when a personal trainer is not present to provide supplementary guidance. Fitness devices must be able to confirm that individual exercises are being performed correctly, according to the optimal schedule, whilst tracking performance and improvement over time. This becomes a complex task. However, users demand simple intuitive solutions – so artificial intelligence enters the scene.



Figure 1: A correctly performed workout by using artificial intelligence

Today's conventional trackers and counters are inherently limited by their design since they are pre-programmed for a generic set of exercises/circumstances. They are relatively simple to use out-of-the-box but are lacking in flexibility, scope and ability to generate actionable feedback. Without intelligence, they are destined to sooner or later spend their time gathering dust in the drawer.

Since current state-of-the-art fitness trackers are unable to automatically identify individual types of exercises when a user switches from one exercise to another, they naturally force the user to physically interact with the device – which is very awkward in the middle of an intensive workout. In addition, these devices are unable to personalize or learn new exercises, further limiting the user's options, frequently failing to recognize even common movements such as jumping jacks or push-ups. To make matters worse, these trackers typically run algorithms on general-purpose processors, which results in high power consumption and frequent recharging of batteries.

Self-learning AI transforms fitness tracking

Now imagine that the tracker is smart enough to recognize new exercises and can adapt to match your own specific workout. This next-generation device learns from your behavior and recognizes hundreds of different movements and patterns – including those that the device manufacturer has not pre-programmed.

Artificial intelligence (AI) stands at the heart of this self-learning system. It enables wearables and hearables to provide personalized, interactive fitness tracking, smoothly adapting to the user's changing activities. Every person is different – in height, weight or fitness level. As there are multiple factors affecting the classification of a given workout such as the number of repetitions, its duration, coupled with the large wide variety of workouts that are available, self-learning AI software becomes the only viable means for providing users with reliable, personalized fitness tracking.

Different strokes for different folks

We can essentially divide people exercising at home into two groups: beginners and enthusiasts. Beginners need lots of guidance, and watching a YouTube video or a Zoom call often fails to provide them with sufficient confidence to know whether they are doing an activity correctly. Instructors with large online classes are often unable to give useful personal feedback. Even when a video tutorial shows exactly what needs to be done, it is often awkward to have to deal with another device during a workout.

For beginners, an AI-enabled self-learning tracker provides detailed and instantaneous feedback. It provides information on the type of activity, the time required and the number of sets and repetitions that need to be done. This is then converted to specific information about intensity and frequency of the exercises, and when users follow a predefined workout plan, they are informed about coming closer to achieving their personal goals such as weight loss, toning or fitness level. Thus, the tracker gives them confidence that their efforts are paying off, and consequently they are

more likely to persist and remain motivated, instead of giving up on exercise as a result of uncertainty.

Enthusiasts have quite different needs. Accuracy and extensibility are key criteria. They want to be able to precisely record and track all of their exercises, and track their performance over time. Based on performance, the device can recommend exercises that target specific muscle groups, for example, to ensure their muscles remain symmetrical. By targeting a certain muscle group, the user may perform a new activity, such as stretching a resistance band, in a way that is particular to them, and the tracker ensures that they do it consistently, e.g. in the same direction every time. Enthusiasts also need to add new activities to their program and so they often explore newer exercise machines and new challenging techniques. The flexibility of a self-learning tracker gives enthusiasts the ability to extend the functionality of the device. Enthusiasts can thus closely monitor new activities even when they frequently switch between various exercises, and receive the feedback that they need.

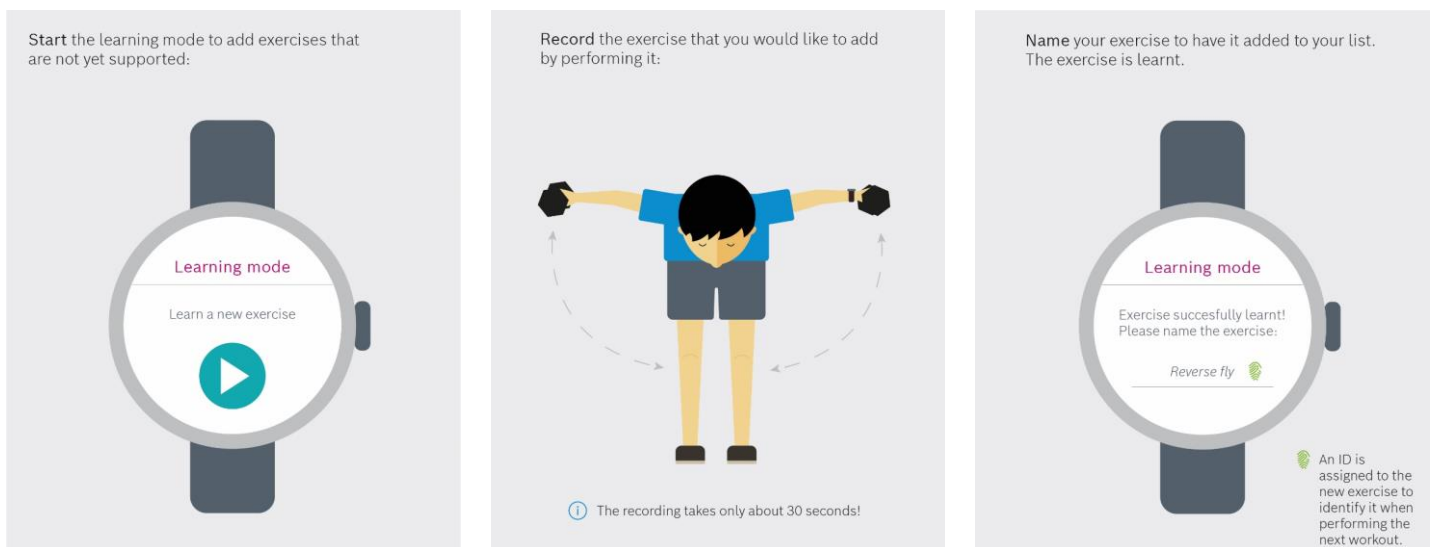


Figure 2: Learning new exercises with the self-learning AI sensor

For HIIT workouts, the user of a tracking device needs to switch quickly between many different activities, for example, exercising for 20 to 30 seconds, followed by 20 to 30 seconds of rest. These activities typically include intense cardiovascular exercises, such as jumping jacks, burpees and running on the spot. The tracking device must automatically and reliably recognize each new exercise upon transition from one to the other, since manual selection is simply impractical. Furthermore, since there is no trainer / coach present when exercising at home, fitness trackers need to account for the variations involved in each individual activity contained in the HIIT workout plan.

An AI motion sensor steps up to the plate

Adding AI to fitness trackers has, of course, been attempted before, but with only limited success. This is primarily due to the limitations necessitated by machine learning techniques, where algorithms are trained using large datasets on cloud-based platforms. Bosch Sensortec has now launched a self-learning AI sensor, [BHI260AP](#), which includes self-learning AI software, a programmable microcontroller and a 6-Axis IMU with the company's proven MEMS technology. The key differentiating factor of [Bosch Sensortec](#)'s approach is that AI capability is provided by the sensor itself, eliminating the need of machine learning on a separate processor, on a cloud or on a smartphone. This minimizes power consumption, ensures security and a longer battery life, and keeps overall system costs low. Users' data can be kept private on the device since there is no need for an internet connection during or after a workout.

To reduce cost and development time, [BHI260AP](#) from [Bosch Sensortec](#) is provided to OEMs and device manufacturers as an integrated all-in-one single package device with embedded AI running inside the smart sensor itself.

The self-learning sensor [BHI260AP](#) is available for direct "out-of-the-box" use with over 15 pre-programmed fitness activities, so users can start using it immediately based on standard templates. Subsequently, the sensor learns the specific movements of the user and how they exercise, and smoothly personalizes to the newly learned activities – this improves accuracy and functionality without the need of a software update, while generating the satisfaction that comes with using a truly personalized device.

Device vendors can, of course, also provide additional activities to the sensor, which can later be loaded on to a tracker by the user. This is a powerful feature, enabling the uploading of personalized datasets from coaches or star athletes, or, providing new functionality relevant to the zeitgeist, giving users even more motivation in their workouts.



Figure 3: The self-learning AI sensor enables an effective home-based training

The fact that AI is embedded directly on the sensor, potentially lends this technology to even more complex tracking applications such as swimming trackers, cycling trackers, dog and horse training. The possibilities offered by a self-learning AI system are limitless, and as device makers know best which aspects of human life matter the most to users, they now have a powerful tool in their hands to craft the next big thing.

Conclusion

As exercising during the pandemic is forced out of the gyms and into our homes, fitness tracking technology becomes a key segment. However, to be viable it needs to provide flexibility, intelligence and a greater scope than provided by current devices. Wearable fitness tracking devices need to adapt to the individual needs and movements of users. In addition to a safe and effective workout, users demand accuracy, personalization and increasing utility value from their devices. They also require the ability to set goals and monitor their improvement over time. By adding self-learning AI capabilities, [Bosch Sensortec](#)'s new movement sensor with self-learning artificial intelligence capability gives tracking devices the features they need to make exercising more automated, personalized, and upgradeable. This makes exercising more motivating and rewarding – whatever a user's level of fitness or experience.

In this fitness video you can learn how the Self-Learning AI Sensor works in practice: [watch video](#).

For any questions or comments, please visit the Bosch Sensortec Community:
community.bosch-sensortec.com.

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