

April 2023: Bringing Vital Signs Monitoring into the Wearable Domain

EBV Elektronik presents key sensors for enabling vital sign sensing in wearables.

Fitness

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April 2023

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In the past, the recording of data concerning patients' vital signs was carried out solely by medical professionals within specialist clinical facilities. It is now becoming increasingly apparent, however, that this places huge constraints

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technology outside of hospitals or other medical units, and have these activities conducted at home.

The global market for vital signs monitoring is currently worth \$5.3 billion, according to figures compiled by industry analysis consultancy Research and Markets. Furthermore, the company predicts that this market will witness a compound annual growth rate (CAGR) of around 6.3% over the next five years - reaching an annual worth of close to \$7.2 billion by 2027.

A tactical adjustment

The validity of moving vital signs monitoring out of the clinical environment and making it more reliant on wearable devices is beyond doubt. By doing so it will be possible for several major difficulties that the healthcare sector has been facing for many years to be overcome. These include:

- Alleviating pressure on medical staff/resources - With the healthcare systems in many countries having to deal with staffing shortages and budget cuts, the prospect of offloading certain time-consuming activities will be very appealing.
- Addressing the increasing prevalence of chronic conditions and an aging population - Factors like air pollution and poor diet are leading to a larger proportion of people suffering from chronic health complaints. Two examples of this that are worth noting are the rise in the cases of type 2 diabetes (which have tripled in the last two decades) and asthma (which has almost doubled in that period). On top of this, there is a shift in the global population's age demographics, with a much greater percentage being above 60 years old than there was previously.
- Improving patient safety and avoiding unnecessary stress - The disruptive effects that having to visit a hospital causes, especially on particularly frail patients, can be severe. They may have to travel considerable distances, and also being in such environments could expose them to viruses (such as COVID) or other forms of infection. Being able to monitor a patient's condition while they remain at home will be much more convenient and far less traumatic for them.
- Enabling better quality of life - For the elderly or those with debilitating infirmities, vital signs monitoring can be pivotal in helping them to continue living independently. Not only does this mean they can have a more enjoyable time, but it also places less strain on overcrowded care homes.
- Implementing a predictive strategy - If medical conditions can be caught earlier on, the cost associated with subsequent care will be curbed dramatically. By having continuous streams of data on

direct actions (such as surgery) can be undertaken on acute problems before they get worse.

- Making individuals more responsible for their health - Aligning vital signs monitoring with wearable technology is not just advantageous from a professional healthcare standpoint. There is a huge demand emerging within the consumer electronics sector for such functionality, as an ever larger proportion of people want to have a better grasp on their fitness levels and overall well-being. Smartwatches with built-in fitness tracking capabilities, smart rings, and even hearables will be just some of the conduits through which data is captured and compiled accordingly. It should be noted that, by giving insurance companies access to this data, individuals will be able to secure lower-cost life insurance.

Ways of ascertaining vital signs data

There are a multitude of different sensing techniques that can be employed in vital signs monitoring. Here is a brief overview of the most prominent of these:

- Electrocardiogram (ECG) - This relies on electrodes detecting differences in electrical potential generated by the heart. Through it, cardiomyopathy (a weakening of the heart muscle), arrhythmia (an irregularity in heartbeat), and other heart-related peculiarities can be investigated. It is also possible to determine pulse transit time (PTT) using ECG signals. This is the period that it takes a pulse to pass from one point within an artery to another. It gives an accurate evaluation of blood pressure without requiring the use of an inflatable cuff. This makes it much more convenient than conventional blood pressure measurement methods. Though ECG machines were previously large and costly, meaning this technique could only be used in a clinical setting, there are growing opportunities for wearable devices into which ECG functionality has been integrated.
- Photo-plethysmography (PPG) - Here applying modulated light emissions to body tissues enables the measurement of pulse rate. Though the rest of the area subjected to the light emissions remains unchanged, the contraction/expansion of blood vessels causes alterations in light intensity to be picked up by photodiodes. Heart rate (HR), respiratory rate (RR), and heart rate variance (HRV) can all be determined via this methodology. Peripheral capillary oxygen saturation (SpO2), which shows how much oxygen is in arterial blood (and can result in sleep apnea if too low), may also be calculated using it. Like ECG, provided that

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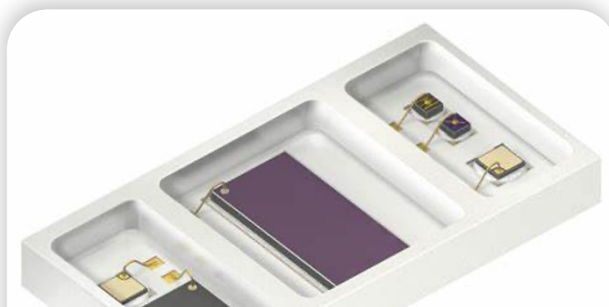
negatively impact its accuracy. Through the introduction of

superior optoelectronic components (such as high lumen output LEDs and sensor devices with better sensing resolution), in conjunction with more complex algorithms and accelerometer inputs (that compensate for movement), higher precision data can now be retrieved. PPG capabilities are thus becoming more commonplace in wearable designs.

- Temperature monitoring - Having an accurate non-contact temperature measurement mechanism is going to be another important aspect of wearable vital signs monitoring. By taking surface skin temperature measurements then extrapolating these, a person's body temperature can be estimated to a high degree of accuracy, thereby eliminating the need for invasive measurements. The quality of the sensed data will be best at places where the skin temperature is closer to the body temperature. This is why OEM development of smart rings (worn on fingers) and earbuds (located within the ear) is now underway.
- Fibre Bragg Gratings (FBGs) - There is the prospect that this optical technology could be utilised in a vital signs monitoring context. FBGs can be created by laterally exposing single-mode fibre cores to periodic patterns of intense laser light and then measuring the incremental differences in light levels. By incorporating FBGs into smart textiles, they could act as micro-level strain sensors that react to fluctuations on the skin's surface caused by the movement of blood through vessels. Consequently, HR, RR, and blood pressure might all be calculated. Though research in this area is still in its early stages, there are high expectations for this technique.

Key product innovations

As a valued distribution partner for the world's leading semiconductor vendors, EBV Elektronik continues to provide the market with a trusted and reliable source of the latest technology for both medical and fitness-oriented monitoring. Here are a few examples of the products stocked for this purpose.



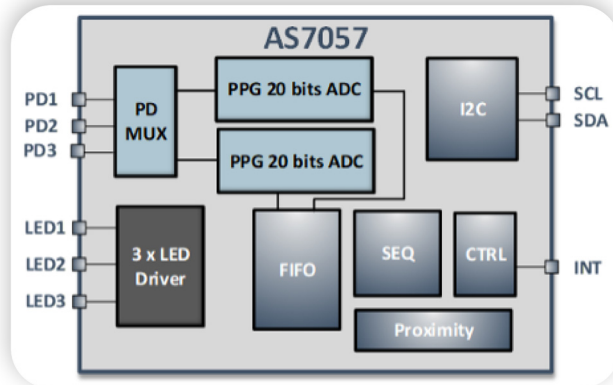
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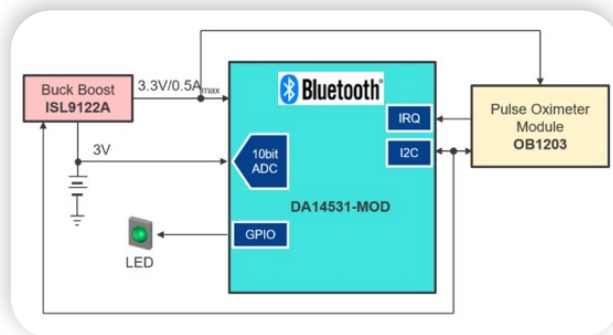
*The SFH 7072 biomonitoring sensor module
from ams OSRAM*

Via EBV, ams OSRAM's SFH 7072 offers a compact but function packed solution for vital signs monitoring. Thanks to its small size (with 7.5mm x 3.9mm x 0.9mm dimensions), it can be applied to fitness trackers and smartwatches for capturing medical data. This multi-chip module is comprised of two photodiodes, two green emitters, one red emitter, and one NIR emitter. Light barriers are incorporated to prevent optical crosstalk from occurring. Through the optical engineering advances it leverages, this solution achieves elevated levels of sensitivity. It is able to take accurate PPG measurements for HRM and pulse oximetry monitoring.



*ams OSRAM's AS7057 sensor AFE for vital signs
monitoring*

The [AS7057](#) bio-signal sensor AFE developed by [ams OSRAM](#) features three photodiode inputs and three LED drivers. As two of the photodiode inputs are able to operate independently of one another, with automatic photodiode offset control, higher-quality results can be achieved. Supplied in a chip-scale package, this unit has an ultra-small form factor that makes it optimised for deployment within space-constrained applications, such as in-ear medical monitoring activities or earbud-based fitness trackers. Not only can this unit detect PPG and PTT signals for HRM and HRV measurement, it can also measure SpO2 and blood pressure. Built-in proximity detection means that the device can go into power-saving mode when not in use, allowing battery charge to thus be retained.



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medical usage. The reference design showcases various items from the company's technology portfolio. These include the OB1203 multi-channel light sensor module, the DA14531 SmartBond TINY BLE module, and the ISL9122A ultra-low quiescent current non-inverting buck-boost switching voltage regulator. There is also an accompanying mobile app available. Leveraging the OB1203 module, HR, pulse oximetry, and SpO2 figures can be obtained. 3200Sps sample rates are supported and up to 18-bit data resolution. The board (which has 4.2mm x 2mm x 1.2mm dimensions) can easily be installed into smartphone handsets, body-worn monitoring patches, and even gym equipment.

Conclusion

Availability of data on the various different vital signs parameters discussed in this article will be of huge benefit to society. It will mean that medical practitioners will have greater insight into their patients' state of health, allowing them to respond more quickly to situations. At the same time, by having access to such data, the public at large will be much more aware of their health and may proactively attempt to make improvements.

With a strong prior track record, the application engineering team at EBV Elektronik is able to offer in-depth technical support to designers working on wearable devices for health monitoring purposes. Advice can be given with regard to which optoelectronic components, wireless modules, analogue ICs, and power discretes should be specified. You can engage with them by clicking [here](#).

About EBV Elektronik

EBV Elektronik, an Avnet (NASDAQ:AVT) company, was founded in 1969 and is the leading specialist in European semiconductor distribution. EBV maintains its successful strategy of personal commitment to customers and excellent services. 240 Technical Sales Specialists provide a strong focus on a selected group of long-term manufacturing partners. 120 continuously trained Application Specialists offer extensive application know-how and design expertise. With the EBVchips Program, EBV, together with its customers, defines and develops new semiconductor products. Targeted customers in selected growth markets will be supported by the Vertical Sales Segments. Warehouse operations, complete logistics solutions, and value-added services such as programming, taping & reeling, and laser marking are fulfilled by Avnet Logistics, EBV's logistical backbone and Europe's largest service centre. EBV operates from 65 offices in 29 countries throughout EMEA (Europe – Middle East – Africa). For more information about EBV Elektronik, please visit www.ebv.com.

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Sam Draper

April 1, 2023

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