

Wearable Technology Trends in Healthcare

Jan-Hein Broeders, Healthcare Business Development Manager

In an interview with EO News in Italy, Analog Devices' Jan-Hein Broeders, healthcare business development manager for Europe, discusses medical market trends and how recent developments in technology continue to further benefit our health and improve our lives.

What are the markets of interest for Analog Devices and what is ADI's current offering?

Analog Devices is a semiconductor manufacturer and solutions provider for several industry markets. We have five target markets: industrial, communications, automotive, consumer, and medical. The medical market can be divided into several subsegments. These include medical imaging, vital sign monitoring (VSM), and medical instrumentation. We are active in every subsegment where market demand typically varies by region and due to geographical location. Noticeably, over the last couple of years, VSM has been one of the fastest growing segments in every region.

Ten years ago, VSM applications were mainly found in hospitals and professional rescue units such as ambulances and helicopters. The biggest market was for bedside monitors and monitors in intensive care departments. These high-end systems support multilead ECG measurements, oxygen saturation, body temperature, and CO₂, and measure several other parameters. Now, VSM is becoming a part of our day-to-day lives. Wearable VSM systems make it possible for physicians to remotely monitor their patients. Instead of recovering from a surgery in the hospital, patients can be discharged sooner and recover in the comfort of their home. This not only helps reduce costly medical expenses but can also improve recovery time as recovery is often quickened in a private environment. Remote VSM systems can also allow elderly people to live independently for a longer time. With the aging population, elderly care houses are becoming unaffordable, so a remote monitoring system enables fewer professionals to monitor a bigger group of people. VSM for sports and exercise is trending as well. This helps people not only monitor their vital parameters, but also shows feedback on whether the exercise is effective.

Can you speak about ADI's portfolio of sensors and how easy it is to integrate them into a device?

The market has changed rapidly. ADI used to make individual building blocks for signal conditioning and conversion into the digital domain. Now we support complete analog front ends that include everything from the analog input stage up to the digital interface, including self-calibration and temperature compensation. We also include the sensor element where possible, so we now have single chip solutions for biopotential measurement, bioimpedance sensing, optical PPG measurement (for heart rate, heart rate variability, and SpO₂ monitoring), motion tracking, and accurate body temperature sensing. All these subsystems have integrated ADCs, so it is very easy to measure a certain parameter and include



the measurement readings in your final application or system without the need for building a complex circuit diagram with discrete components.

Optical sensors make it possible to measure heart rate at a single spot on the body, but you can also measure heart rate variability (a measure for stress level detection) or oxygen saturation (the percentage of red blood cells carrying oxygen). We started with discrete amplifiers to interface photodiode currents, followed by analog front ends, conditioning the photocurrents, and then integrated current sources to control the LEDs used for controlling the light emitted in the system. Because not every electronic engineer is an optical engineer, we developed a half-dozen optical modules. These modules combine the analog front end, one or more photodiodes, and the required LEDs to support a complete optical system. These are very small and optimized to reduce time to market and cost in this very competitive market.

What are your latest solutions in the field of healthcare?

With reference to our latest introductions, we recently launched a biomedical analog front end called **ADPD4000**. In a wearable device, you often measure more than just one parameter, such as heart rate, activity, skin impedance, oxygen saturation, and body temperature. Why would you use an individual chip or sensor for every measurement? Doing so would increase the overall board size, the required power, and, certainly, the overall system cost. The latest introduction makes it possible to do all these measurements, with exception of motion, with just one chip. The chip directly connects to biopotential electrodes to measure cardiac signals. It's able to measure galvanic skin response for stress or mental state tracking. It has eight inputs to measure photocurrents and eight current sources to drive LEDs. In addition, the chip supports auxiliary inputs to measure capacitance and temperature. With a chip like the ADPD4000, you can build a wearable VSM system that's very power efficient, small, and cost-effective.

How has this changed the way our health is monitored in the last years?

The medical market used to be doctor-centric, meaning that we used to only visit a doctor when not feeling well or for a more obvious health problem, for example, after having an accident. Technology—and especially the electronic industry—has had a big impact on the overall healthcare market while creating a more patient-centric approach. We, as the consumer (or patient), have more options on how to monitor our health conditions and where to go for our healthcare and medical services. While having access to wearable devices, we can monitor important vital parameters on a daily basis and are able to detect changes or anomalies at a much earlier stage compared to the past when we only recognized an issue when it impacted our well-being. The advantage of monitoring our parameters and detecting anomalies at an earlier stage is that we can start the treatment of certain diseases before they progress and cause permanent damage to the body.

As an example, there are many people suffering from hypertension, which is also known as high blood pressure. In some situations, this is a well-known issue; however, there are also many occasions where hypertension isn't causing any visible symptoms. Over a longer period, this high blood pressure can result in either stroke, heart failure, arterial fibrillation, or several other risky diseases. Hypertension can be treated very easily by lifestyle changes and medication to reduce the risk of health complications. Wearable devices that are monitoring critical vital parameters can frequently save lives or prevent health events that may lead to permanent damage.

Another good example where wearable devices can improve lives is for those who suffer from diabetes. Depending on the severity, diabetics must monitor their glucose levels a few times per day and rely on taking insulin to regulate glucose levels. Though most diabetics may become accustomed to this over time, it can be an inconvenient and burdensome disruption to daily life. There is a new trend, now moving from the blood glucose monitoring (BGM) approach toward a continuous glucose monitoring (CGM) system, which is made possible by wearable sensing technology. With this technology, glucose levels can be measured continuously throughout the day, while an insulin pump injects the required insulin in order to stay in range. As this will be a closed-loop approach, the burden is lifted from the consumer (or patient). This will have a big impact on daily life, providing freedom from the disruption that diabetics so often deal with. Technology—and especially wearable devices—is proving to have invaluable benefits, both in terms of preventative measures or for those that are already diagnosed with a well-known disease.

Analog Devices is working on many sensors and sensor solutions for the medical market that will help to improve our quality of life. When you would like to learn more, please have a look at analog.com/healthcare.

About the Author

Jan-Hein Broeders is the healthcare business development manager for Analog Devices in EMEA. He works closely with the healthcare industry to translate their present and future requirements into solutions based on Analog Devices' market-leading linear and data converter technology, as well as products for digital signal processing and power. Jan-Hein started in the semiconductor industry more than 20 years ago as a field applications engineer and has been in his current healthcare role since 2008. He holds a bachelor's degree in electrical engineering from the University of 's-Hertogenbosch, the Netherlands. He can be reached at jan.broeders@analog.com.

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T21852-11/19

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