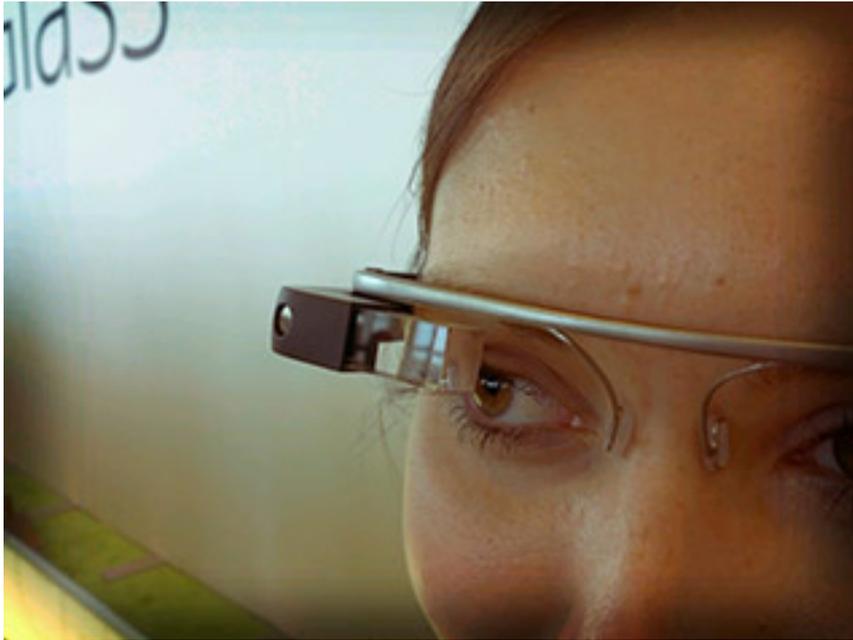


Wireless Energy Harvesting to Power the Internet of Things

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Game changing wireless, batteryless devices create upswing trend for new consumer electronics and other industries



Internet technology will move from being something that is kind of independent of us to something that is literally woven into our daily existence. From your shoes to your shirt, stove to your toilet, the future may be found in connecting every part of our lives. This is referred to as the “Internet of Things (IoT).” Yet a fundamental problem still remains. How to power all these devices?

“The idea of devices that charge themselves continuously, without intervention, access to electrical outlets, or unwieldy cords, has been prevalent among both developers and users for some time,” says Eric Woods, research director with Navigant Research. “This is the future of devices – and the technology to make it happen has arrived.”

The Technology

As defined by Wikipedia, energy harvesting (also known as power harvesting or energy scavenging) is the process by which energy is derived from external sources (e.g. solar power, thermal energy, wind energy, salinity gradients, and kinetic energy), captured, and stored for small, wireless autonomous devices, like those used in wearable electronics and wireless sensor networks.

In our hyper-connected world, we create a good deal of digital waste. Cell towers, TV towers and even Wi-Fi hotspots constantly deliver wireless communications to a

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host of devices. And now those signals and waves will not go unused. These waves can be harvested and used to power new types of sensors and wireless devices. The result is a new technology that operates without the use of batteries. It equates to wireless self-sufficiency.

Already in early 2012, the International Electrotechnical Commission (IEC) acknowledged the power of energy harvesting technology, ratifying EnOcean as the standard. It is the ISO/IEC 14543-3-10 standard for wireless applications with ultra-low power consumption and the first and only wireless standard that is also optimized for innovating energy harvesting solutions. This international standard sets the framework for achieving a fully interoperable, open wireless technology similar to such standards as Bluetooth and Wi-Fi.

From a product design perspective, the opportunity is immense. Imagine these sensors embedded in everything from structures to vehicles to clothing. An office in a skyscraper might alert someone that lights have been left on, a vehicle might alert you if the child safety lock has been tripped or your favorite radio talk program starts in 5 minutes; sneakers could let you know when you've reached their optimal mileage threshold. Or what if tunnels could be capable of alerting someone if stress-related cracks form, couches that sing out after they've swallowed your keys and the option to send text messages or emails with "wearable" technology that is battery-free.

According to Industry Analysts

Juniper Research forecasts that worldwide spending on wearable technology will hit \$1.4 billion this year and predicts that figure will hit \$19 billion by 2018. There is a heightened consumer awareness of wearable technology that is spurring on this fast growth. Juniper reports that the market's growth will, of course, be a good thing for device makers and, developers might benefit as well. This addition of opportunities that is arising for app developers will add an additional layer of complexity and coordination within the product design process technology that operates without the use of batteries. It equates to wireless self-sufficiency.

Expect to see device manufacturers coming out with an abundance of new product designs across the fitness, sports, and communication industries as well as health. For instance, device manufacturers that will be deploying energy harvesting will be seen in such applications as telemedicine systems and m-health or mobile health initiatives as a way to implement ruggedized handset communications for all clinicians.

According to the Department of Electronic and Computer Engineering, Hong Kong University of Science and Technology, energy harvesting and power delivery for implantable medical devices sees the different state-of-the-art mechanisms that do "in-body" energy harvesting as well as "out-of-body" wireless power delivery that are becoming more and more in existence. Providing a constant and perpetual energy source is a key design challenge for implantable medical devices.

For medical devices, energy harvesting technology would eliminate the need for

bulky batteries and the risk of battery-related defects. “Energy harvesting is becoming an increasingly viable source of power for a variety of devices, especially where the environmental and economic costs of maintaining batteries is untenable,” says Bob Gohn vice president of Pike Research. “Consumer products such as laptops and mobile phones are already being powered by energy harvesting technology.” Gohn believes medical device will be the next market to capitalize on the benefits of energy harvesting.

Wearable Technology’s Four Segments

According to ResearchMoz, energy harvesting technology-enabled devices and even wearable technology presents the potential for massive transformation in many industries. The more obvious ones include consumer electronics and communications. Early adopter industries of wearable technology include clothing, healthcare, sports and fitness. In addition, we see many industries adopting batteryless technologies. Expect to see device manufacturers coming out with an abundance of new product designs across the fitness, sports, and communication industries as well as health. For instance, device manufacturers that will be deploying energy harvesting will be seen in such applications as telemedicine systems and m-health or mobile health initiatives as a way to implement ruggedized handset communications for all clinicians.

The four end-user segments of the wearable technology products fall into fitness and wellness, Infotainment, healthcare and medical, and industrial and military. The fitness and wellness segment comprises products like smart clothing and smart sensors, activity monitors, sleep sensors and others, whereas the Infotainment sector consists of products like smart watches, heads-up displays, smart glasses and others. Examples of the healthcare and medical device products could be continuous glucose monitors, drug delivery, monitors, and wearable patches, to name a few. And, of course, in the industrial and military segment, you’ll find products like hand worn terminals and augmented reality headsets.

Getting These New Products To Market

With these new and expected products come an opportunity for emerging start-ups and a wide variety of small and medium size businesses (SMBs) to deliver new or enhanced products and gain a competitive advantage. Leveraging a Product Lifecycle Management (PLM) system to help efficiently develop these products is key to a successful launch. Omnify Software is one PLM provider that quickly saw how it could help these SMBs do just that by providing an alternative to traditional PLM designed for larger companies. Electronic device, sensors and some of the newer cutting edge product manufacturers are looking to PLM to streamline and optimize their design process and ultimately help them get to market faster. However, they may not have the budget of a Boeing or Ford, in which a PLM solution geared to address an SMB’s needs would be more appropriate.

For instance, Petra Solar uses Omnify Software to bring its Smart Energy Solutions to market faster. Their PLM solution automates and streamlines processes around document control, engineering changes, for computing and wireless

communications that integrate into virtually every aspect of products and services.

Other energy harvesting companies like Lord MicroStrain Sensing, are using Omnify Software for managing the product lifecycle of their smart, wireless sensors that are in use in such applications as advanced manufacturing, off-highway vehicles, commercial and military manned and unmanned vehicles, civil structures, and downhole tools. Lord Microstrain's design and engineering team was able to enhance and enforce business processes using a PLM system as well as develop advanced integrations with their engineering design and manufacturing environments.

The PLM software implementation has resulted in a decrease of MicroStrain's BOM processing time from two to three days to just minutes. The engineers can access approved parts stored in PLM from within their CAD program. The BOMs generated from the engineering systems are imported into PLM for approval and the released BOM data is sent directly to the ERP for a completely automated and streamlined process. They found their PLM solution helped them to get to market first, stake a larger market share, and maximize profit margins.

The Consumer Electronics Market

According to ResearchMoz, the market potential for energy harvesting markets was reported at \$131.4 million in 2012 and projected to increase to \$4.2 billion in 2019. Anticipated growth is based on global demand for sensors and wireless sensor networks that permit control of systems, especially as seen in the consumer electronics market.

Consumer electronics (a \$209B industry) tend to rely heavily on batteries. Energy harvesting technology is powering a growing number bill of material (BOM) management and compliance. The company has reported improved efficiencies with an estimated 74% time savings in engineering change order (ECO) cycles.

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Consumer electronics (a \$209B industry) tend to rely heavily on batteries. Energy harvesting technology is powering a growing number of consumer and industrial products that need to become freed from having to use electrical outlets. Not too far down the road, energy harvesting will be used as fuel to power batteries for electronic devices and smart phones. The energy is captured and converted from vibration and thermal differentiation that is ambient in the environment.

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Heightened Consumer Demand

Device designers will be looking at using energy harvesting technology for wireless batteryless storage devices. Existing energy harvesting applications include vibration-based wireless train measuring systems, wireless sensors distributed citywide to implement smart cities, oil field monitoring systems and windup laptops for use in remote regions.

With the augmented customer demand for smart phones, tablets, laptops, digital cameras and home entertainment devices, you would think that the consumer electronics market was sitting pretty and enjoying large profits. The reality is many consumer electronics companies have become so price-driven with fierce competition. It is no wonder that differentiation of competitive products and compressed time to market have become critical to a consumer electronics business being profitable.

The consumer electronics and device market is watching closely such trends as energy harvesting and wearable technology to help them ensure a first mover advantage in their highly competitive industry. They have also come to realize that it is absolutely paramount to invest in product lifecycle management to be able to invent while at the same time accelerating their time to market. Product lifecycle management systems really help minimize costly product errors and manufacturing delays, which for the consumer electronics sector is critical, seeing that their product innovations are typically complex and have frequently changing parts.

Manufacturing for consumer electronics and wearable devices is taking place in shifting global locations with components coming from possibly anywhere around the world along with sales happening everywhere. What we are seeing as the main trend with PLM is that it is enabling manufacturers to streamline and manage global supply chains by providing visibility across the enterprise's entire product lifecycle,

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even in other countries.

The Projection Looks Good

Keep your eyes peeled for business opportunities as this new market emerges. Powering small electronic devices such as wireless sensors, smart-building and industrial equipment controls, wellness and wearable monitors will proliferate the market and create a positive impact. Not only does it protect the environment by reducing CO2 emissions, while eliminating batteries and power cabling, it will also finally enable the IoT ecosystem and ignite the creation of many new products.

Not too far in the future, we will see hundreds of millions of these kinds of devices deployed in environments such as office buildings, houses, hotels, industrial sites, transportation infrastructure and electric vehicles. The development cycle for devices will shorten even further. PLM will be a tremendous benefit to managing the design and production process for companies to stay competitive. Analysis shows that the energy harvesting market will grow to \$4.2 Billion within five years including the emergence of thousands of developers and design engineers involved throughout the value chain.

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