INSIDE THE INTERNET OF THINGS

Philips has created a connected healthcare platform powered by massive data flows and machine learning

A patient at home with a heart monitor is not really alone. In the new world of healthcare, patients and medical teams are united by a connected experience built by data and insight. The result is highly personalized medicine.

Connected healthcare is all about the interplay between the Internet of Things (IoT) and artificial intelligence (AI) technologies, specifically machine learning and deep learning. The relationship is a little like gasoline injection and an engine: Each one needs the other to produce spectacular results. The fuel comes from data spun from connected devices such as tablets, wearables, handhelds and a seemingly limitless list of sources, including medical monitors, diagnostics from imaging and medical records. The engine driving healthcare forward to better outcomes and lower costs will be smart algorithms and machine learning, which find patterns and make accurate predictions from these massive data flows.

"We're using IoT as part of solutions to gain deeper understanding of a patient's situation—and we can also use it in combination with smart analytics running in the background to start predicting adverse events," says Jeroen Tas, chief innovation and strategy officer at Philips, the Dutch health technology giant. "When we combine the data from devices, systems and services and match it with a deep profile of the patient, we can uncover more and better insights about what drives the improvement of health—and what prevents the deterioration—of this individual. We are really looking at creating a knowledge- and data-based digital model of the person."

THE IOT MEETS MEDICINE

Before the rise of hyper-connectivity, medical experts were unable to see deeply into the context and condition of a patient on a continuous basis. Yet now, with the help of IoT and other technologies, this is possible. In fact, Philips built its HealthSuite platform all around IoT—combining connected device data with medical and behavioral data—as a way to generate a common view of medical data that can be accessed and shared by extended medical teams, who then decide on the next best action.

People with chronic diseases, for example, need to keep a close eye on their vital signs and medication intake. A diabetic has to track blood sugar and insulin dosage; someone with chronic heart disease needs to monitor blood pressure and weight. But that information alone is not sufficient to fully grasp the patient's condition.

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"We actually want to know more," Tas says. "That's why we're creating a trusted network of medical devices. We want to understand the context in which the vital signs manifest themselves. Why is somebody's blood pressure and heart rate high? It may be because she just walked up 20 floors. And when we seamlessly blend in the patient's medical history, we may find relevant information pointing to an emerging, or future, deterioration."

IoT in imaging

Tas speaks about ultrasound imaging of a heart as a prime application of IoT's power in connected healthcare. Philips' portable handheld ultrasound device enables specialists to meet patients at the point of care, almost anywhere, download imaging apps from the cloud, and view high-quality, annotated images on a tablet or smartphone. The quality is so high, he says, that teams can create, very quickly, a quantitative anatomical model of the heart. Based on that information, a doctor may ask this person to perform remote electrocardiograms to monitor heart rhythm and blood flow; information that would be added to this person's medical history.

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"As we learn more about a patient, we build an increasingly refined view of that person's heart in connection to the function of other organs," he adds. "If we look at respiration rate in the context of what we know more holistically about a patient, we can set up a window of intervention and may actually predict cardiac arrest 24 hours in advance."

IOT: THE DATA MELTING POT

That world is only expanding with the increasing number of connected medical devices, such as wearable and ingestible senors or smart pills. Machine learning feeds off input data from connected devices—let's say millions of images and electronic medical records—and infers and interprets the relationships, trends and patterns. Deep learning is a more sophisticated and focused class of machine learning, with deeper layers of neural networks and algorithms inspired by the way biological nervous systems work. Such systems can classify immense data sets—audio, images, video, speech, words—and reach conclusions on their own; conclusions that would not be feasible for the human mind.

Predictive medicine

In just one medical case, Philips' HealthSuite might combine data from a patient's electronic medical records and imaging from sonograms and other radiological tests to build a deep patient profile that can serve as the basis for anticipatory insights. "This is where machine learning comes in," Tas says. "Now you have very complex information—sometimes thousands of data elements— and the machine allows us to derive those early warnings by seeing patterns that indicate something's going wrong and doctors should intervene."

Philips also uses deep learning in radiology or pathology images to detect and quantify cancer: The system can measure the volume and even the contours of the growth; it can identify from that indication the aggressiveness of the cancer and the parts of the cells that are alive or dead. "If we do multiple studies," Tas says, "we can identify the progression of the cancer and compute the probability of the cancer metastasizing into the signal pathways that spread the disease. We combine anatomical data from imaging

and cellular and molecular data from pathology and genomics to create a precise diagnosis as the basis for personalized therapy selection."

IOT: THE BUSINESS CASE

The genius in Philips' HealthSuite platform is its transformation of existing products into smart devices that, with the IoT, are spawning an integral solution approach to its businesses. "We used to sell only equipment such as MR and CT machines," Tas says. "Increasingly, we're building into radiology solutions and extending into cross-modality precision diagnosis. It's a new way of packaging our different products into effective solutions that address real needs. Now we are selling a path to better outcomes from an optimized workflow around very complex procedures. It's a different approach to the market."

IoT + efficiency in action

Tas points to two examples of the IoT optimizing procedures, diagnosis and outcomes. The first is around non-invasive surgery in catheter labs, a big business for the company. The traditional approach had been to sell the interventional cardiology equipment and software. Then Philips added catheters to their portfolio to come to a more complete solution. Now they go even further, helping hospitals and medical practices improve efficiency and outcomes. Tas says the conversation with customers now goes like this: "Let us help you optimize the way you do these procedures. Let us help you prep the patient before he or she comes in. Let us make sure that with every surgery, we learn and share that knowledge with everyone involved. Let us help you do the

post-discharge support of the patient so we can optimize the outcomes and get better every time."

The second example is around modeling. "When you fuse information from connected healthcare, you can build a very personalized view of a patient's body or disease," Tas says. "A surgeon can actually hold a physical model of a patient's heart and look at it from different perspectives. Or he or she can look at a virtual model on a computer screen or on a device using augmented reality. This is also a very good way to prepare for the actual procedure, or to explain to the team and to the patients themselves what's going on and how you can help them with therapy. When everyone is aligned behind very clear goals, it ultimately leads to better health for patients and a more effective system."

IOT: THE FUTURE

Philips is only deepening its pool of data sources with partnerships that will connect even more devices into HealthSuite. Philips also announced a new AI solution called HealthSuite Insights that will lessen the logistical challenges of launching and curating an AI-based environment. The platform will allow the company to create AI assets with clinical partners, and then deploy them in the run-time environment of actual clinical practice.

"The power of IoT and AI combined allows teams to constantly mine data for improvements and insights," Tas says. "The future is really one where smart medical things are connected and data is translated continuously into actionable insights."

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