

Intelligent Sensor Network Platform for Digital Healthcare

DIGITAL HEALTHCARE EVOLUTION

For Intelligent Sensor technologies, healthcare has long been viewed as a promising domain. Intelligent sensor-based applications could improve health outcomes and quality of life for millions of people in the coming years—but only if they gain the trust of doctors, nurses, and patients, and if policy, regulatory, and commercial obstacles are removed. Prime applications include clinical and non-clinical decision support, patient monitoring, wearables, and coaching solutions. It also includes automated smart devices to assist in homes, in surgery, or patient care, and makes management of healthcare systems error-free and flawless. Recent successes, such as mining social media to identify possible health risks, artificial intelligence, and machine learning to predict patients at risk, and robotics to support surgery, have expanded a sense of possibility for intelligent sensors in healthcare. However, with the onslaught of the COVID 19 pandemic there have been glaring weaknesses in these technological improvements as it relates to the methods of patients interacting with medical professionals as many struggled to fully engage with and utilize remote visit functionality due to connectivity issues.



As in other domains, data is a key enabler and a major key to the success ability and access to the data is the “Platform or Infrastructure”. There has been an immense forward leap in collecting useful data from personal monitoring devices and mobile apps, from electronic health records in clinical settings and to a lesser extent, from robots designed to assist with medical procedures in homes, mobile, and hospital operations. But using this data to enable more finely grained diagnostics and treatments for both individual patients and patient populations has proved difficult due to lack of access to intelligent sensor-based network platforms. Research and deployment have been slowed by outdated “Football City-like” network infrastructures as provided with current services provider structures. Poor human-computer interacting methods and the inherent difficulties and risks of implementing these transformational technologies in such old and non-scalable existing networks have slowed the realization of the promise of digital healthcare transformation.

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Edge Intelligent clinic in Industry 4.0

The Fourth Industrial Revolution (IR4.0). IR4.0 is a technical revolution that is ushering in the development and implementation of technology and innovation that enables things like Artificial Intelligence (AI), The Internet of Things (IoT), Nanotechnology, Robotics and 3D printing. Through AI human intelligence is simulated through machines that are programmed to think like humans and mimicking their actions. Through IoT systems are interrelated and objects connected on the internet to collect and transfer data over a wireless network without human interaction. Through Nanotechnology we can see and control individual atoms and molecules in which everything on earth is made up of. By utilizing Robotics, we can design, construct, and use a machine to perform tasks normally done by humans. By utilizing 3D printing a user can have access to the full three-dimensional printing capabilities using a fabrication process that decreased the production time for making things like eyeglasses. As these innovations are implemented, we can begin to see the benefits that innovation brings to business and the global economies. The healthcare industry is working on becoming an industry where the public trust the reliability and safety of IR4.0 technology being implemented.

For decades, the vision of implementing an artificially intelligence clinical assistant for use during doctor visits has been something that could not be done. Even with hundreds of successful pilots and advances in the implementation of artificial intelligence-related technology in digitizing healthcare, we still lack the necessary technology to successfully implement this technology. This is because the network platform supporting healthcare delivery remains structurally ill-suited to absorb deployment of these rapid advances. The incentives provided by the Affordable Care Act have accelerated the penetration of electronic health records into clinical practice. However, implementation has been poor thereby eroding clinicians' confidence in their usefulness largely due to infrastructure barriers.

Looking ahead to the next several years in intelligent clinical advancements and access to intelligent sensor network platforms promises to change the cognitive tasks assigned to human clinicians. Presently physicians routinely solicit verbal descriptions of symptoms from patients and, in their heads, correlate patterns against the clinical presentation of known diseases. With intelligent assistance, the physician could instead supervise this process, applying his or her experience and intuition to guide the input process and to evaluate the output of the machine intelligence. Certainly, "hands-on" experience of the physician will remain critical, solving the significant challenge to optimally integrate the human dimensions of care with automated artificial intelligence reasoning processes.



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To achieve this future in intelligent healthcare services, clinicians must be involved in designing the solutions at the onset to ensure that the intelligent sensor healthcare network platform is designed and deployed securely and can operate in way that meets the needs of the physician and their patients. In the current clinical settings, we have begun to see workloads have increased and physicians are grateful for the help that technology provides in streamlining their daily task. With the new generation of more tech-savvy physicians routinely using specialized apps on mobile devices for in-home elderly care and regular office visits. This illustrates the need for continued investment and implementation of innovative technology in the healthcare industry that supports the operation of AI technology in a way that enables the usage of intelligent clinical assistants that could streamline the diagnostic process and free up the valuable time that physicians spend doing diagnosis of their patients.

Edge Intelligent Healthcare

With advancement in healthcare and the utilization of artificial intelligence functionality to mine outcomes from millions of patient clinical records, Clinicians can now perform more detailed analysis of patient's symptoms to provide them with a more personalized diagnosis and treatment plan in a shorter amount of time. As intelligent Edge network functionality provides computing technology that is a distributed, open IT architecture that features decentralized processing power, enabling mobile computing and Internet of Things (IoT) technologies that will assist in the automated discovery of genotype-phenotype connections and make it possible for the implementation of routine genome sequencing for each patient.

To tackle this challenge Dalet Access plans to implement an overall strategy that consists of deploying an adaptive sensor-based network infrastructure that is known as an Intelligent Sensor Networks (ISN). This type of network is one where Sensor Networks, Signal Processing and Machine Learning are integrated and focused on closely managing the sensing, networking, and smart signal processing using machine learning technology solutions. This interface will interact with fully automated healthcare platforms to implement advanced diagnostic options. This allows us to offer customers our solution at a lower cost with limited-power requirements and small-sized equipment. With this solution, our customers have access to specific or multiple functional wireless communicating devices that smartly processes data and provides real-time information that enables them to grow or shrink their service requirements based on the utilization in real-time.



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Traditional and artificial intelligent generated healthcare data, augmented by social and other artificial intelligent enabled platforms will lead to the emergence of self-defined sub-populations, each managed by a grid-like ecosystem of healthcare providers. This is augmented with the use of an intelligent sensor network and monitoring systems. This new ecosystem has the potential to radically transform healthcare delivery as medical procedures and clinical records for hundreds of billions of individuals become available for regular access and management. Similarly, the automated capture of data from intelligent sensor networks solutions like wearable devices and smart assistance devices will expand personalized medicine options. These activities are becoming more commercially viable as new providers discover ways to engage large populations and then create population-scale data that can be mined to produce individualized analytics and recommendations.

Access to intelligent sensor-based platforms will enable human clinicians to conduct interactive therapy sessions with multiple patients simultaneously with the aid of algorithms trained by the clinicians. These platforms will extract behavioral patterns, create alerts from data collected from a patient's smart device, and will lead to real-time early detection of health issues in patients. Combined with the emerging trend of more specialized motion tracking devices at the edge, such as Fitbit, and the emerging (inter)connectedness of the home environment with health-monitoring devices is fueling a vibrant new sector of innovation in intelligent digital healthcare transformation.



The shift to intelligent sensor network platforms in concert with predictive adaptive functionality across all applications will likely spur new solution offerings. Imagine app-assisted devices such as smart-walkers and smart-wheel chairs that not only propose a schedule of exercise for the client but also warn when the client is pushing too hard. Likewise, although automated image interpretation has been around for decades, natural language algorithms are being leveraged to assist in the interpretation of big data sets of poorly labeled images.

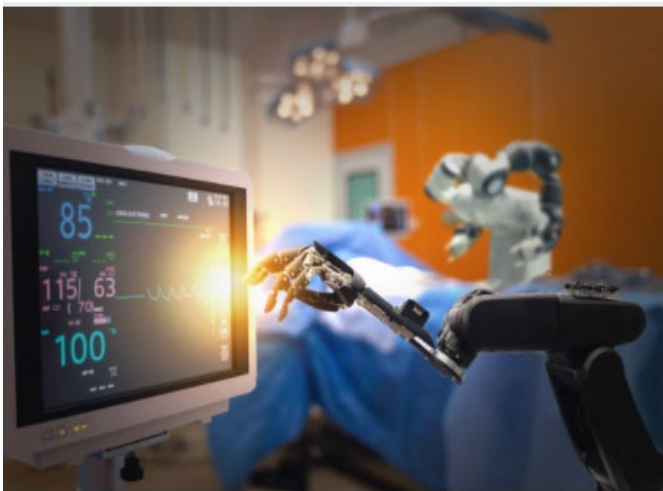
Several barriers have limited the deployment of these technologies. Traditional networks that cannot accommodate time-sensitive traffic or scale to the dataflows required by information-intensive applications are blocking the implementation of these technologies. For instance, one of the many problems in healthcare is to not only recognize the subjects of X-ray or ultrasound

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images but to make fine-grained diagnostic judgments in real-time. Traditional healthcare network platforms make this type of functionality very difficult and results in excess time and expense to make it possible. As image interpretation of natural language processing gains momentum, the demand for intelligent sensor network platforms is increasing, as is the platform's capabilities to intelligently support the application workloads, the Dalet Intelligent Network Platform framework can provide a solution that will enable the seamless flow of data for health diagnostics with the hopes of improving patient care at a lower cost and with ease of use.

Intelligent Healthcare robotics and Home-bots

"Closed-Loop" digital healthcare in the Industrial Revolution 4.0 is attainable with access to real-time data that is intelligently used to assess data quality and performance metrics to meet SLA commitments. Closed-loop digital healthcare systems will be proactive in identifying deficiencies and errors, and they will have the capability to self-optimize to improve performance. In other words, this intelligent platform will facilitate making the connection between what is done, and the outcome achieved, making a true closed-loop intelligent digital healthcare transformation possible.



About twenty years ago, healthcare robotics were largely science fiction, but a company called Robodoc developed a robotic system to assist in orthopedic surgeries such as hip and knee replacements. Robodoc's technology worked, but it struggled commercially, and it was ultimately shut down and acquired for its technology. More recently, though, the research and practical use of surgical robotics has exploded and will continue to grow, especially in wrist instruments, ergonomic solutions, and for home-assisted devices for the elderly.

Looking ahead, many common tasks in healthcare will be amenable to augmentation, but they will not be fully automated immediately. For example, robots may be able to deliver goods to the right location in a hospital, private clinics, and to homes. But the tasks performed by humans to place them in their final location will still be performed by humans. Intelligent walkers, smart wheelchairs, or other physical assisting devices will extend the range of activities of an infirm individual. Walking a patient down the corridor may be relatively simple once a patient is standing in a walker (though will certainly not be trivial for patients recovering from surgery and/or elderly patients, especially in corridors crowded with equipment and other people). A robotic needle to suture a wound is relatively straightforward technology once the needle is correctly placed. This implies that many future digital healthcare tasks will involve intimate interactions between people and robots with natural augmentations.

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The growth of automation at the edge will enable access to new insights into deploying digital healthcare processes intelligently. For many decades, robotics use was seen as strong data-driven or data-oriented science, with the right combination or access to be serviced via an intelligent platform. This is the new normal as automation infiltrates digital healthcare transformation into Industrial Revolution 4.0.

As new surgical, delivery, and patient care digitally comes online, quantification and predictive analytics are being built on top of data coming from these platforms, real-time access to these edge data will be used to accomplish these tasks. The networks delivering these latency-sensitive applications must meet and exceed SLA commitments that include user quality of experience, proactive identification of errors and deficiencies, and be secure and adaptive to changes. This network makes the connection between what is done, and the outcome achieved. Dalet Access Labs' sensor-based intelligent network platform makes true "closed-loop" digital healthcare attainable. Dalet Access Labs' sensors are proactive, self-defending in nature, and they continuously learn and adapt to user behavior to identify and protect against potential threats. The platform will improve health and wellness mobile applications and treatment devices, and to bring about the needed intelligence to eldercare—especially in communities of color where there has not been a significant focus on these populations in relation to access to healthcare. By extending cloud-based intelligent edge sensors to hard-to-reach locations, all communities in the United States will now have an expandable model.



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COMPANY PROFILE

Dalet Access Labs is a leading Network As A Service (NAAS) provider. We utilize the intelligent self-organizing sensor-based network platform to enable digital healthcare transformation by providing ultra-low latency edge intelligent broadband. It also has the capability to support intelligent clinic and analytics, natural language processing, virtual reality, augmented reality and industry 4.0 applications that gives an unparalleled customer user experience. As the complexity of network infrastructures and application bandwidth usage increases, the ability of network operators to conform to stringent SLAs will potentially be challenged. We will make it possible for even the most demanding Fourth Industrial Revolution (IR4.0) services to be successfully deployed by leveraging self-organizing, smart-decision sensors at the edge of the network. This allows for optimal performance, and our self-defending proactive management algorithm to continuously learn and adapt to user behaviors to identify and protect against potential outages and threats.

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