Improving health outcomes with AIoT

Human motion digitization for connected remote clinical assessment

The issue

Facing a growing administrative burden and surging patient loads, care providers have no option but to find more efficient ways to deliver accurate, high-quality care to patients. As a result, health care leaders are actively seeking to transition to a value-based care model. This model creates new opportunities to drive down costs while improving patient outcomes, giving care providers strong incentives to better engage with patients and enabling more widespread adoption of evidence-based medicine in diagnosis and treatment.

The good news is that digital health care innovations are happening at an unprecedented pace and scale, giving care providers new tools for making care delivery more efficient, accessible, economical and patient-centric in a value-based care model. Artificial intelligence – machine learning specifically – is already providing compelling examples of this type of technology-aided innovation at work. By collecting and analyzing high-frequency Internet of Things (IoT) sensor data, along with computer vision, health care organizations can enhance human performance on cognitive tasks such as diagnostic or therapeutic decisions, supporting clinicians in treating diseases.

For example, routine physical assessments of balance and mobility are common health care activities with significant potential to be transformed by combining IoT and AI technologies – the artificial intelligence of things, or AIoT. The standard assessment for a variety of balance- and mobility-related pathologies – applicable to patients in stroke rehabilitation and treatment for Parkinson's disease and arthritis – is the Berg Balance Scale (BBS). The BBS is used to functionally assess a patient's ability to maintain balance during a series of 14 specific movement-related tasks, scored on a scale of zero to four. And while it has been the standard for years, it has clear limitations. For starters, the test is a highly manual process that can take more than 20 minutes and requires assessment by a trained and skilled observer. It is also subjective and qualitative, relying heavily on the individual observations of caregivers.

Clinicians routinely assess arthritic patients undergoing treatment with the BBS in order to understand their pretreatment severity. They also use it to assess post-treatment recovery and progress, creating an ideal opportunity to apply IoT sensor-based measurement in tandem with AI capabilities. With AIoT techniques, care providers can simplify assessment by using fewer steps while making the test quantitative, consistent and reproducible.

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The SAS and Intel Difference

The promise of AI, IoT, and advanced analytics – along with fast-emerging developments in the field of AIoT in health care – has been widely anticipated for years now, and recent advances in each of these areas are quickly making these integrated capabilities a practical reality. Health care leaders looking to start small in areas such as motion analytics and then quickly scale up must be confident that the underlying technologies are capable of handling the challenges that come with managing large amounts of data at scale.

This is where the combination of SAS Analytics software and Intel processors can make all the difference. Our technologies, working in close collaboration, have been put to work on some of the most complex analytics challenges for some of the largest organizations in the world. This is exactly the type of tested expertise required by health care providers, who are operating in a highly complex environment. If your organization is seeking ways to use AI, IoT and advanced analytics to transform its approach to patient care – not just in enabling better clinical assessment, diagnosis and treatment, but anywhere – we should talk.

Our approach

SAS researchers have developed advanced, AIoT-enabled motion analytics tools for digitizing routine balance and motion assessments. This solution marshals IoT capabilities, motion monitoring tools, machine learning and advanced analytics to deliver a more accurate assessment of patients' movements – much faster than today's traditional methods.

The solution includes the following hardware and software components:

Hardware

- IEI Tank AIoT Developer Kit with Intel Xeon processor.
- x-io Technologies NGIMU (Next Generation IMU).*
- MetaMotionR (MMR) nine-axis IMU and environmental sensor.
- Intel RealSense 3D camera.
- Netgear Nighthawk AX4 four-stream Wi-Fi 6 router.**

Software

- SAS® Analytics for IoT.
- SAS® Event Stream Processing.

With these tools in place, mathematical models describe the preoperative condition of the patient as recorded in the assessment – a quantitative baseline. From there, models are used to score and track rehabilitation progress and, ultimately, to evaluate the effect of surgery in terms of therapeutic efficacy compared to the primary diagnosis.

This system records a host of measurements – far more than any clinician can effectively measure. The data is fed into a machine learning model, and in the case of osteoarthritis treatment, can ultimately be shared across providers treating others affected by this condition. Over time, routine assessments are fed into the same model, which allows doctors to track patient progress with pinpoint accuracy in rich detail, seeing patterns that would have otherwise remained hidden. Using machine learning with data from new patients, the models themselves improve over time. And as data volume increases, SAS software, in combination with Intel processing power, ensures scalability.

Benefits

- Drive greater accuracy and consistency of measurements in both the individual and across a cohort.
- Create and build on a baseline of clinical data at the individual patient and system level.
- Measure what the human eyes cannot see.
- Gather and log data in less time.
- Reduce the burden of the assessment on patients.
- Enable clinicians and other care providers to focus on higher-value aspects of patient care.
- Facilitate remote assessment of the patient, including from home and other care facilities.
- Identify novel clinical assessment endpoints.
- Develop methods to quantify and evaluate the efficacy of treatment on pain, discomfort and disequilibrium.
- Reduce the cost of common and frequently executed motion-based clinical assessments.

To learn more, contact Khondoker Huq at Khondoker.Huq@sas.com.

* IMU = inertial measurement unit.
** Dual-band (2.4 GHz/5 GHz) gigabit Ethernet.