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SENSOR BASED TECHNOLOGIES AT THE EDGE

AN OVERVIEW OF INSPIREN'S APPROACH TO SENSOR TECHNOLOGY IN HEALTHCARE

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Overview

Clinical care lacks necessary tools that allow staff to refocus their effort back to the bedside. The disparate healthcare solutions requiring rounding documentation, manual data entry, and additional FTE resources result in more time spent in the EMR. We believe that Hospital Systems and Senior Care Communities must pivot to real-time technologies that keep providers digitally connected to the care environment. However, it is not a singular problem. It is a multidimensional problem that can only be solved by multiple technologies.

Core Technologies

Among the technologies that aid in real time monitoring, three prominent sensor based solutions are:

- Computer Vision
- Proximity Beacons
- Environmental Sensors

Computer Vision

Powerful trends in mobile computing and machine learning are propelling advances in computer vision, the process of extracting high level information from image data.

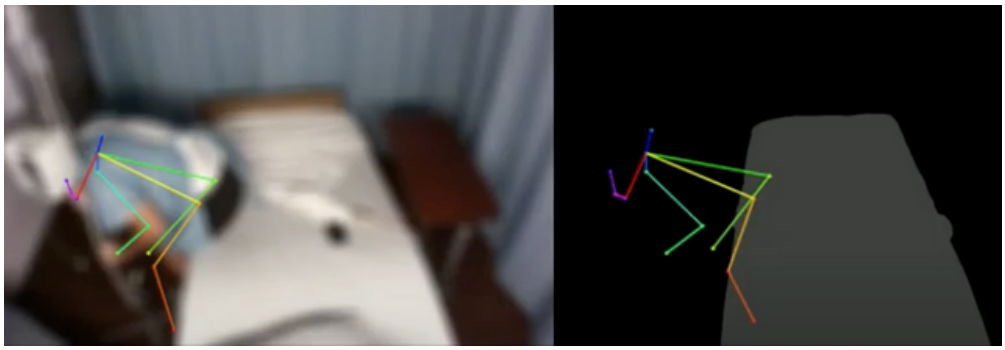
Thanks to the widespread adoption of mobile devices, high resolution digital imaging sensors have become readily available. With the addition of a wide-angle lens and infrared illumination, these sensors can capture detailed images of an entire room, day or night.

Computer Vision example: AUGi uses a high-resolution camera and Edge AI to detect and identify people or objects in a room.

Deep learning is a cutting edge machine learning approach where multi-layered neural networks learn how to detect and classify the information content of raw data using only labeled examples. This technique is enabling scientists to discover drugs and auto makers to develop self-driving cars. For computer vision applications in indoor environments, deep learning models enable the recognition of common household objects, such as beds, couches, and chairs. They can also detect people and their body positions and orientations.

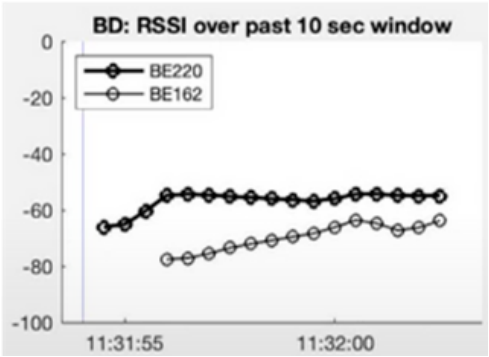
Advances in low power computing have enable consumer electronics to apply deep learning computer vision at the point of sensing ("on the edge"). Edge AI allows for the capture of clinically-relevant events without the need to transmit image data that could contain other sensitive information.

Pose Model example: AUGi employs machine learning pose models to track human behavior in a room.



Proximity Beacons

Detecting the presence of a particular person or piece of equipment can be essential to getting the full context of care delivery. Proximity beacons, which can be embedded in smart lanyards and asset tags, provide this capability. A device installed in the care environment continuously scans for broadcasted messages from the beacons and determines when the identified entity enters and exits its proximity. Bluetooth Low Energy is one such standard for proximity beacons that benefits from low power consumption that enables longer battery life, use of mobile devices as beacons and scanners, and advanced capabilities targeted at indoor positioning applications.



Proximity Beacon Example:
Proximity beacon systems use wearable, battery-powered devices that transmit periodic messages detected by scanning infrastructure.

Environmental Sensors

Environmental sensors capture diverse information passively from the indoor environment. Examples include ambient light sensors, ambient temperature sensors, and microphones. Knowing whether the lights are on or off, the relative temperature of the room, and the noise level give context that forms a fuller understanding of an occupant's state at a glance. These measurements can also be compared against baselines to alert on unusual state.

How the Technologies Stack Up

Each technology has benefits and drawbacks when used in isolation to solve a specific business or clinical need.

	COMPUTER VISION	PROXIMITY BEACON	ENVIRONMENTAL SENSORS
BENEFITS	• Single camera can cover a room • High Intelligence In detecting various objects and events • Ability to Identify object and human changes In location and position In real-time	• Precise at identifying the person or asset wearing the beacon • Identity is encoded in beacon transmission • High accuracy In general location of the asset or person	• Capture real-time fluctuations from the baseline measurements • General applicability • Data can be used In conjunction with other technologies
DRAWBACKS	• Limited to line of sight from the camera lens • Auxiliary sensors needed to capture Information outside view of the lens • Identifying a person requires inference	• Low level of detail on proximity In relation to other objects or humans • Multiple scanners may be necessary to differentiate areas of a room or apartment	• Lacks specificity In the causes of measurement changes • Low value when sensors are used In Isolation without other technologies

Using These Technologies

Utilizing the best of Computer Vision, Proximity Beacon, and Environmental Sensor technologies solves the multi-dimensional problem and enables superior performance in real-time monitoring. By combining these technologies together in one single form factor, the drawbacks of each singular technology in Isolation is mitigated by the benefits of the other solutions, creating a building effect.

The AUGi platform, which stands for augmented intelligence, fuses together these multiple technologies to empower healthcare organizations to improve their clinical and operational performance through data driven decisions. The future of IoT success in healthcare will hinge on minimal footprint and singular low-cost, low maintenance hardware that requires no infrastructure change. But it shouldn't stop there, architecture and infrastructure accelerators such as Edge AI must also be used when considering an enterprise solution.

About Inspiren

Inspiren, a nurse-led technology company, is dedicated to helping hospitals and elderly care facilitates reduce adverse events, ensure staff safety and satisfaction, and mitigate infection control. Inspiren's platform, "AUGi", is an award winning, computer vision and hybrid sensing technology that intelligently analyzes patient behavior, interactions between providers and patients, room environmental factors, IoT enabled medical devices, and personal protective equipment, to provide unparalleled insights to protect patients and safeguard staff. Inspiren (Brooklyn, NY) is located in the 84k square foot innovation space New Lab at The Brooklyn Navy Yard.