CASE STUDY

SHUTTLEWORTH

Robotics, Smart Conveying Streamline Specimen Handling at ARUP Labs

EXECUTIVE SUMMARY

Motoman and Shuttleworth team up to design a showpiece of automation in medical specimen handling at the University of Utah's national reference lab, ARUP Laboratories – one of the largest medical testing laboratories in the U.S. – capable of storing 2.3 million samples and processing 4,000 specimens per hour.

ARUP Laboratories is not only one of the largest medical testing laboratories in the United States, it is also one of the most automated. Sporting the world's largest clinical laboratory freezer, 60′ x 30′ x 26′ in size, and operating at minus 20°C with a two-story automated storage and retrieval system (ASRS) that can hold up to 5,220 stainless steel storage trays of specimens on indexed shelf locations, the system's capacity exceeds 2.3 million individual specimens. At the heart of the operation is a highly-automated sorting and transport system consisting of two robotic sorters designed by Motoman - which load and unload finished specimens into storage trays – and continuous-flow "smart" conveyors built by Shuttleworth, which jointly retrieve and transport specimens for clinical testing in less than 2.5 minutes with a capacity of handling 4,000 specimens per hour. For high-volume, efficient laboratory specimen handling, the system is truly a showpiece of precision automation.

But it wasn't always this way for Associated Regional and University pathologists, Inc. (ARUP Laboratories, or ARUP), who for 20 years prior to automation was manually handling specimens. A national clinical and anatomic pathology reference laboratory and a wholly-owned enterprise of the University of Utah and its Department of Pathology, ARUP was created in 1984 by the University of Utah School of Medicine' Department of Pathology faculty to support academic missions of education and research. ARUP support d the Department of Pathology by providing laboratory testing for the University of Utah Hospital and clinics while engaging in cutting-edge technology needed to establish ARUP as a leading national reference laboratory specializing in esoteric testing. ARUP has established itself as a role model for bridging the gap between academic medicine and successful business enterprise.

"Before automation, ARUP was using walk-in freezers at three different locations to store specimens, "says George Falk, Project Specialist at ARUP's Central Support Services Group. "The samples were stored manually in cardboard trays, with a capacity of about 400,000 specimens. To find a sample, a tech had to go into the walk-in freezer with a box number (an X/Y reference) and search manually. Personnel were required to enter the freezer in pairs for safety reasons, wearing coats, when looking for a specimen, a labor-intensive and time consuming process."

Critical to the ARUP system's success is its automated transport and sorting system which includes rapid transport to and from the specimen processing area and high-speed sorting into a large number of different sort groups. From even the most remote specimen processing workstation to the farthest sorter (There are two robotic sorters), travel time on the 1,100 linear-foot track is less than 8 minutes.

The Solution

Two sorting robots, AutoSorters® built by Motoman, are attached to the automated rack system. Optimized for high throughput, these robots automate the transfer of tubes from the automated track system into storage trays or racks for entry into the freezer for storage. Then when a sample needs to be recalled for testing the AutoSorter receives the storage tray or rack from the freezer and retrieves the designated sample which is then conveyed out to the requesting lab tech. Both of these functions were previously a manual process. Trays are used to store tubes in storage categories of higher volume and racks are used for lower volume categories. A reader mounted on each of the robot's four grippers reads barcodes as the tubes are rotated by the robot, eliminating the need to otherwise orient the barcodes. Each sorter can sort up to 2,000 tubes per hour into 30 user-definable lanes. The combined sorting capacity of the sorters – 4,000 tubes per hour – is 100 percent greater than the previous manual system's capacity of 2,000 tubes per hour.

The AutoSorters are positioned within a large refrigerator (4°C) located at the front of the freezer, which serves as an anteroom to the freezer. When the automated doors to the freezer are opened to allow trays to go in or out, the environmentally controlled humidity of the refrigerator ensures that condensation does not form on the outside of the specimen tubes, which would inhibit reading the labels and barcodes on the sides of the tubes.

Specimen trays entering into the refrigerator through the AutoSorter robot cells need to be precisely positioned for the robot grippers to contact the specimen tubes before releasing to the automated storage and retrieval system I the freezer for archiving. Likewise, specimens exiting the freezer from the automated storage and retrieval system must again be precisely positioned to accommodate the exact placement of the AutoSorter robot grippers in the refrigerator before releasing to the laboratory. This is accomplished through a specialized system of continuous-motion input and output conveyors designed by Shuttleworth.

The conveyors are roller conveyors that enable integrated devices allowing motion control of the specimen tubes. Product stops, pushers and clamps used to modify the flow of the tubes are all mounted below the surface which is critical because of the robotics moving above. If these devices were coming in from the side, such as what would be required on a belt conveyor, plastic link conveyor or a table-top chain conveyor, they would interfere with the robotic arms.

The conveyors are also equipped with Slip-Torque® technology which minimizes sample damage by creating low back-presser accumulation, Low line pressure throughout the continuous-motion accumulation conveyors allow for precise product

placement with the AutoSorters. The conveyors can continue to take product flow from the upstream line for a period of time instead of stopping. A low-pressure accumulation buffer absorbs irregularities in the production flow, and provides a smooth, even flow on the line.

Slip-Torque utilizes individually-powered rotating roller shafts and loose-fit rollers, which become the conveyor surface, powered by a continuous chain to control the drive force for the samples, The size and weight of the tubes determine the driving force and roller selection, When the samples stop on the surface of the conveyor, the segmented rollers beneath them also stop, generating low back-pressure accumulation, minimizing sample damage.

The conveyor system utilizes stationary roller shafts covered with loose segmented rollers which allow the same conveyor to be split into three independently-operating lanes. For example, the middle lane can accumulate, while at the same time the right lane and the left lane can both convey. Each land can act reducing energy costs.

The Shuttleworth system conveys and positions a master rack and a series of sample trays, the robotic cell then transfers specimens from the master rack to the various sample trays depending on what tests or diagnostics are to be performed, the deck of the AutoSorter holds up to 39 racks. Specimen loading and unloading is managed by the continuous-flow conveyors, providing walk-a-way time sufficient to meet the needs of the lab. With an overall retrieval time of less than 2.5 minutes, the requested tubes are typically in a rack waiting for the employee when he arrives at the checkout station.

RESULTS

"Tacking of the specimen has improved greatly." Explains Falk. "We know immediately where the specimen is. There are labor savings, time savings and the system is much more convenient."

The automated handling system put in place for ARUP Laboratories presents a showpiece in high-volume and efficient specimen processing. Such automation might only be economical for those labs handling high volumes of specimens daily, in the range of 15,000 to 20,000 samples. But those labs that do make the switch from manual practices to a highly-automated facility will not only experience a more efficient operation, but be in a better position to capture and hold market share into the future.

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From automotive and electronics, to paper conversion and pharmaceuticals, to food and consumer good markets and beyond, manufacturers across the globe rely on Shuttleworth's proven product handling solutions to increase line efficiency, maximize profitability, and minimize risk. As part of the ProMach Product Handling business line, Shuttleworth helps packaging customers protect and grow the reputation and trust of their consumers. ProMach is performance, and the proof is in every package.

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