LabLinx: Automation of Labware Transport with a High-Speed, Portable, Modular, and Expandable Conveyor-Based System

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INTRODUCTION

Labware transport is a critical component of any laboratory automation system. Labware transport is defined as the movement of labware in the traditional "microplate footprint", including 96-, 384-, and 1536-microplates, deepwell plates, filter plates, tube racks, and disposable tip racks.

Lab automation solutions are used by primary HTS, ADME, genomics, and proteomics laboratories. A range of functionality can be automated, from plate processing such as washing or sealing to complete screening assays. A large variety of devices that are based on the microplate footprint are available from dozens of vendors, including liquid handlers, readers, washers, dispensers, sealers, incubators, and more. Most of these devices process one plate at a time, so lab automation systems are designed to provide a steady supply of labware to whichever devices are required. This labware transport function can be accomplished with stackers, stationary robotic arms, track-mounted robotic arms, or various combinations of the above.

LabLinx is a new Labware Transport system developed by Hudson in response to the changing demands of the lab automation environment. By keeping as many devices as possible directly online with the conveyor, speed and reliability are increased by moving the labware directly into the operating environment of the instrument and eliminating the requirement to use a robotic arm.

COMPONENTS

(1) StackLink. For storage and online-feeding of labware. The stacker uses an active mechanism for reliable pickup and release of labware. The stacker has two stacks each with a capacity of 30 or 60 standard microplates.
(2) ArmLink. Simple Pick & Place Robot that quickly moves labware from the track to devices that are not directly integrated with the conveyor.
(3) TrackLink. Modular sections of conveyor in various lengths. These connect to each other as well as StackLinks to build a system.
(4) StopLink. Accurately stops and positions a microplate for access for processing such as washing or dispensing.
(5) SoftLinx. New multitasking software with VB interface and access to Hudson's interface programs for > 100 microplate-based devices.

Figure 1: ArmLink and Stacklink with 2 TrackLink conveyor sections.

CONFIGURATION

LabLinx uses a modular design which allows a variety of systems to be configured. The devices to be integrated and the required throughput parameters are the starting determining factors for building a system. Examples from simple to complex are shown.

Automation of a single device for walkaway automation

A common requirement in many labs is the processing of a batch of 20-100 plates on a single device such as a washer, dispenser, or sealer. The online StackLink stackers provide an efficient means of presenting and storing plates.

Whenever possible, the system is engineered to interface "online" with a third party device. Online means that the plates can be processed while remaining on the track, eliminating the need for a robotic arm mechanism. Figure 2 shows a plate-washing workcell that uses a StackLink integrated with a modified Bio-Tek ELx405 Washer for online processing.

Figure 2: StackLink integrated "online" with Bio-Tek ELx405 Washer.

Automation of liquid handling platforms

Even liquid handlers with large deck capacities need extended automation capability in order to process larger numbers of plates for processes such as replication, reformatting, dilutions, reagent additions, and hit picking.

The LabLinx system is ideal for increasing the labware capacity of liquid handlers since labware can be presented directly onto the deck without the need for handling by robotic arms. Plates can be accurately positioned with StopLink modules for online 96-, 384-, or 1536-well pipetting. TrackLink sections can be linked together to reach completely across the deck, and any labware, including disposable tip racks can be transported. Multiple plates can be presented to multiple positions on a liquid handler deck, allowing parallel operations that greatly increase throughput.

LabLinx stackers can be configured adjacent to liquid handler decks to supply plates or tips. The system is capable of positioning several microplates on the liquid handler deck, allowing more efficient automation of processes such as plate replication, since multiple plate types can be delivered. It is even possible to configure track sections that span completely across the liquid handler deck, allowing stacks to be configured on either side.

Figure 3: LabLinx integrated with Sias Xantus liquid handler. 3 stop positions are configured on the conveyor, which spans the liquid handler deck and connects 2 StackLinks.

Automation of a multiple devices for efficient workcells

LabLinx is modular and expandable, allowing a virtually limitless selection of workcells to be built by configuring the desired stackers for capacity and adding track sections for both online and offline processing devices.

Figure 4 shows a workcell that includes online plate dispensing on a liquid handler deck, and online processing to a washer.

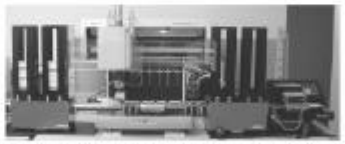

Figure 4: LabLinx integrated with Packard Multiprobe liquid handler and Bio-Tek ELx405 washer.

High throughput is achieved in this workcell through the design effiencies of LabLinx.

Plates can be moved to and from stacks, to multiple deck positions, and to the washer without the need for any robotic arms.

With a stacker on each side of the liquid handler, plate movement can be programmed in one direction for more efficient movement.

Assay system automation

An automated system capable of performing a complete assay can be easily configured by connecting the required components, as shown in the system in Figure 5. Because the LabLinx system is modular and installed on the benchtop, a system such as this can be quickly reconfigured in the lab if the assay conditions change.

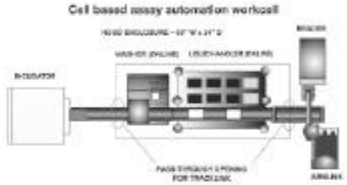

Figure 5: LabLinx system configured for automation of a cell-based assay. The modular and compact design of LabLinx allows connection of devices inside a hood to devices outside the hood.

OPERATION

The LabLinx system is programmed and controlled with Hudson's SoftLinx Lab Automation software. SoftLinx includes a multitasking executable that provides dynamic scheduling capability. Hudson has written interfaces to > 100 lab automation devices. End users can also write their own interfaces in VBA if desired.

SoftLinx uses a graphical drag-and-drop method editor that allows the user to program labware movement among all of the connected modules, including the LabLinx modules and third party devices.

SoftLinx employs an event-driven dynamic scheduling algorithm to ensure the most efficient use of the robotics within the workcell. Each device owns its own processing threads, and it is possible to run parallel threads within a single method, allowing further increases in throughput.

CONCLUSION

Hudson LabLinx offers an exciting new alternative to other labware transport strategies. Hudson has gained extensive experience with the automation of a variety of microplate-based devices, and LabLinx is based on our users' inputs.

LabLinx is a high-speed, conveyor-based system that is modular, easily expandable, and able to be installed on the benchtop, providing automation opportunity within today's budget constraints for laboratories both small and large.