Robotics in action at the National Library Board – Mobile Bookdrop, Reservation Lockers, Shelf-reading Robots and Auto Sorter

Singapore, 29 September 2020

Please see below details on the robots and automated technologies that NLB has harnessed.

1	**Shelf-reading robot**  NLB piloted the first shelf-reading robot at Pasir Ris Public Library in Jan 2018. With the successful trial of the shelf-reading robot then, NLB has since deployed 13 robots at five other libraries. On a nightly basis, each robot will scan the Radio Frequency Identification (RFID)-tagged books on the library shelves after the library's opening hours. It will then churn out a list of books that have been mis-shelved. The robot also gives a virtual view of the book and which shelf it was misplaced on, so that staff can locate it and place it at the correct shelf in the morning.

	The system maintains an up-to-date database of scanned items and their locations, which can be used to facilitate item retrieval and stocktake. With that, library staff can focus on re-shelving the misplaced books highlighted by the robots after their nightly scan. It has eased the manual and labour-intensive task of staff having to check the spine labels of books on shelves to identify wrongly shelved books. The shelf-reading robots have also led to savings of $750,000 annually in terms of manpower costs. Found at the following libraries: 1. Pasir Ris Public Library 2. library@harbourfront 3. Sengkang Public Library 4. Serangoon Public Library 5. Bedok Public Library 6. Tampines Regional Library *Further Details:* **Navigation and shelf scanning** The robots use laser mapping and ultrasonic sensors to navigate a complex maze of library shelves, including curved shelves, while remaining at a critical distance to shelves for optimal scanning. **Obstacle detection** Several sensors, including cameras, sonar sensors and cliff sensors have been added to improve detection of glass surfaces and obstacles such as staircases that are commonly found in libraries. **Telescopic arm** The robot is equipped with a telescopic arm to move laterally to different heights of the bookshelves. **Patented antenna design** The antenna is optimised to detect high frequency RFID tags found on the library books at up to 99% accuracy levels.
2	It has been deployed at Tampines Regional Library since December 2017 to enable patrons to conveniently return their books. Books are automatically processed as 'returned' when dropped into the bookdrop. When the bin is full, the robot will follow a magnetic strip on the floor and travel to the sorting area. When it arrives, it will send a signal to the sorting room to alert staff to replace the bin.

	The mobile bookdrop enhances staff productivity and eliminates the need for staff to spend time walking across the library to collect the items. The mobile bookdrop is well-used by patrons. 2,000 books are returned per day via the mobile bookdrop.
3	**Auto sorter**  The auto sorter was first piloted at library@chinatown in 2013. It automatically sorts returned books into different categories, taking away the laborious manual task of doing this. This has improved productivity and achieved a high level of accuracy in sorting returned items. It has also led to savings of $750,000 annually in terms of manpower costs. The auto sorter can be found at all public libraries except library@esplanade.
4	**Reservation locker**  The reservation locker was first piloted in 2014. Situated mainly outside libraries, the lockers provide a round-the-clock service that allows patrons to collect reserved books at any time. Once the staff places the books in the respective lockers, the system informs patrons via email that they are ready for collection. Library patrons enjoy the flexibility and convenience to collect items outside of library opening hours. This has also enabled NLB to transit to counterless libraries and led to a savings of $360,000 annually in terms of manpower costs. The reservation locker can be found at all public libraries except library@chinatown.