AUTOMATED INVENTORY SCANNING SYSTEM FOR EFFICIENT OUTBOUND DISTRIBUTION

CHALLENGE OWNER

The Challenge Owner is a global leader in healthcare products, with a diverse portfolio including pharmaceuticals, medical technologies, and consumer health products. They have a history of more than 135 years and employ more than 130,000 employees globally. The scope of this challenge focuses on its Distribution Centre in Singapore, which is the Regional Distribution Centre (RDC) for the entire APAC region, focusing on MedTech products.

This sector-wide ROS-I Startup Challenge is organised by the ROS-Industrial (ROS-I) Consortium Asia Pacific and the Advanced Remanufacturing and Technology Centre (ARTC) which is led by the Agency for Science, Technology and Research (A*STAR), in partnership with Nanyang Technological University Singapore.

ROS-Industrial Consortium Asia Pacific and its organising partner ARTC, aim to accelerate innovation in the robotics sector by focusing on the unique integration of cutting-edge ROS capabilities in manufacturing. The challenge will feature 2 problem statements from the industry that will proliferate the adoption of Robot Operating System (ROS)-based solutions in industrial applications. It will also facilitate collaboration between startups and ROS-I's technical teams to provide joint innovative creations to leading global enterprises from ROS-I's consortium.

To Note: Participants should approach this challenge with the intent to utilise A*STAR's intellectual property to resolve the problem statement and give due consideration to license, post-challenge.

CONTEXT

The Challenge Owner's RDC is handled by third-party logistics (3PL). It receives products from manufacturers around the region and ships all APAC orders from Singapore.

The current outbound distribution process is as follows:

1. When an order comes in, the operator will receive a list of Stock Keeping Units (SKUs) to be picked from the shelves of the warehouse.
2. Once picked, SKUs are placed in 122cm x 102cm trays and the operator will scan the barcodes on the SKUs using a handheld scanner. The barcodes can be either 1D or 2D.
3. The backend ERP system will verify the information received from the scanner (European Article Number, batch ID, expiry date) and will assign a Handling Unit (HU) to the SKUs. The HU is an identifier for the gaylord boxes which the SKUs will be packed into.
4. The operator does a visual inspection of the SKUs to ensure quality and packs them into a gaylord box with the assigned HU.
5. When a HU is fully loaded and there are still remaining SKUs to be packed, the operator will update the system. The system will assign the remaining products a new HU and the operator will open a new gaylord box and continue packing.
6. If there are rejects, (e.g. defective item) the operator will inform the ground manager for a decision on the next steps (e.g. discard, repair or replace).
7. There may be specific packing requirements (e.g., requirement for temperature checkers) for different orders which the operator will adhere to. There are also typically different SKUs in one box, stacked in multiple layers.
8. Upon completion of an order, the operator will inform the ERP system and a shipping label will be printed. The sealed gaylord box will then be placed in the outbound staging area.

The current throughput of the RDC is approximately three million SKUs a year, or around 12,000 a day. Each order that goes through the outbound process could contain between 100 to 10,000 SKUs. Due to the high volume of orders and diversity of SKUs that needs to be processed, the current manual process poses the following challenges:

- Process inefficiency. There are currently four operators who handle their respective orders, following the same scanning and packing process at their own workstations. During high order season, the 3PL will need to engage additional manpower to fulfil the increase in volume of orders on time.
- Abortive and repetitive work. In order to verify if an order has been completed correctly, the operator will need to manually check that the number of SKUs scanned matches the order list. This can only be done after all the SKUs within an order have been scanned. If a discrepancy is discovered, the operator will have to unload all the items and repeat the whole outbound process again to rectify the discrepancy.

100% accuracy is required as this is the final stage of the outbound distribution process. The Challenge Owner has tried other inventory scanning solutions in the past, including scanning tunnels and a robotic vision-based detection system. However, the following challenges resulted in the RDC returning to the manual scanning process:

- Large variety of MedTech products. The SKUs come in a wide range of shapes and sizes. The SKUs can be as small as 6cm x 6cm boxes, and up to 1.5m long equipment. Their corresponding barcode sizes also differ. The smallest barcode size is 6mm by 6mm (2D DataMatrix) and largest is 90mm by 13mm (1D).
- Lack of control over SKUs' production processes. As the SKUs come from manufacturers from across the region, each will have their own protocols and packaging procedures. The Challenge Owner does not have control over the type of barcodes being used nor the final packaging standards. Some packages may have several layers of shrink wrap which could be reflective and may affect the barcode scanning.
- High frequency of inventory changes. There are often new SKUs being introduced or old ones being discontinued within a year. Product design also changes approximately every three years. This renders solutions that require object detection model training less effective and unscalable.
- Lack of a fallback mechanism in the event of a mis-scanned SKU. When SKUs are missed out in the scanning process, the current system is unable to point out which SKUs were not scanned. The operators will have to manually rectify the problem.

PROBLEM STATEMENT

How might we accurately automate the inventory scanning process to allow for early error detection, and improve efficiency for outbound distribution?

WHAT ARE WE LOOKING FOR?

The Challenge Owner is looking for an automated barcode scanning solution that allows the operators to focus on the visual inspection and packing process. The solution can be a combination of hardware and software components.

The solution should meet the following criteria:

- Ability to handle various SKUs. The solution should be able to handle the periodic changes in product inventory i.e., introduction of new products and decommissioning of old products without major disruption to the process.

- Flexible and sensitive in detecting the barcodes. As the SKUs come in varied sizes and packaging, the barcodes on the products also differ in sizes and types (1D & 2D). The solution should be able to detect barcodes of different sizes and types without additional configuration between scans. The smallest barcode is approximately 6 x 6mm and the largest is 90mm by 13mm.
- Highlight discrepancies. If the system is unable to scan any of the SKU barcodes, it should identify the missed SKUs so that the operator is able to perform corrective actions (e.g. re-scan manually, let the solution scan the item(s) again, or set aside the item for separate processing for damaged or missing barcodes). The system should also be able to highlight any discrepancies in the items picked against the order so that the operator can rectify.
- Ensure product quality throughout the scanning process. The proposed solution should not damage the products in the process of scanning.
- Safety requirements. The solution must take safety considerations into account while operating in the warehouse. For robotic solutions, they should adhere to ISO safety standards. For further reference, please refer to the link here[1].
- Size considerations. If the proposal includes a physical system, the dimensions of the system should be within 3m (W) x 5m (L) x 2.5m (H).

OVERALL PERFORMANCE REQUIREMENTS

- Speed. The system should minimally be able to scan 10 products per min (ppm).
- Usability. The system should not require operators to perform complex configurations. Pre-registration of configurations with easy execution is ideal. Any additional steps should not require technical knowledge.
  Accuracy. For the POC, the Challenge Owner will provide backend ERP data in .txt and .xml formats for offline matching to assess accuracy in the scanning process.

There are no restrictions on the geographical location of the problem solvers who may choose to apply to this challenge. However, the problem solvers who are keen to utilize A*STAR's funding for technology development must register/have registered a private limited company in Singapore. . The prototype must also be demonstrated in Singapore.

METRICS OF SUCCESS

The solution should aim to have the following desired outcomes:

- Reduce annual manpower needs by 10-30%. With a reduction in manpower required to do the manual inventory scanning, the need for engaging additional manpower to meet order demands should be reduced.
- Reduce expenditure by 50%. Overall cost savings with a more efficient and accurate inventory scanning system.

POSSIBLE USE CASES

1. Automated barcode scanning. James is an operator working at the RDC. An order comes in and he picks the items according to the order. He places the items he has picked into a tray and the new system scans the barcodes on the SKUs. While the system is scanning the barcodes, he is able to perform visual inspection of another order. Once the scanning is done, the system informs him that all items match the order list. He does a final visual inspection of the SKUs and packs them into the gaylord boxes to be ready for shipment.

[1] https://www.nrp.gov.sg/engineering/standards/

2. Detection of incorrect and unscanned items. James places the items he has picked into a tray and infits the SKUs into the new system for scanning. Halfway through the scanning, the system prompts him that it has detected an error. The system informs him that there are three items which were not scanned and identifies the items for James. The system also identifies that there were two items which were picked incorrectly and did not belong to the order list. James picks out the unscanned items and rescans them. He then removes the two incorrect items and the system informs him that the scanning is now complete. He inspects the items visually and packs them for shipping.

WHAT'S IN IT FOR YOU

- SGD50,000 of prize money for each winner of this challenge (see Award Model)
- SGD150,000 A*STAR funding for technology development*
- 3-year ROS-Industrial Consortium Membership
- Access to IMDA's PIXEL corporate innovation hub and complimentary innovation consultancies (e.g. Design Thinking, Digital Storytelling) for the prototype development and commercialisation
- Opportunity to commercialise solution for deployment and adoption by ROS-Industrial consortium members

**To access the A*STAR funding for technology development problem solvers must register / have registered a private limited company in Singapore to utilize the funding.*

EVALUATION CRITERIA

The evaluation process shall take place over two stages. Proposals shall be evaluated based on the evaluation criteria set out for the first stage. Thereafter, shortlisted proposals shall be subjected to a second stage evaluation in the form of an interview / pitch, and the scoring shall be based on a re-defined assessment criteria for the selection of the challenge finalist(s).

Solution Fit (30%)	Relevance: To what extent does the proposed solution address the problem statement effectively?
Solution Readiness (30%)	Maturity: How ready is the proposed solution to go to the market? Scalability: Is there any evidence to suggest capacity to scale?
Solution Advantage (20%)	Quality of Innovation: Is the solution cost effective and truly innovative? Does it make use of new technologies in the market, and can it potentially generate new IP?
Company Profile (20%)	Business Traction: Does the product have user and revenue traction? Team Experience: Do the team members possess strong scientific/technical background?

AWARD MODEL

30% of the prize money will be awarded to each selected finalist at the start of the POC/prototype development process. The remaining 70% will be awarded after completion of the POC/prototype solution, based on milestones agreed between Challenge Owner(s) and the solver. Prize money will be inclusive of any applicable taxes and duties that any of the parties may incur.

Note that a finalist who is selected to undertake the prototype development process will be required to:

- Enter into an agreement with Challenge Owner(s) that will include more detailed conditions pertaining to the prototype development;
- Complete an application form with IMDA that will require more financial and other related documents for potential co-funding support.

DEADLINE

All submissions must be made by **13 Sep 2024, 1600 hours (SGT/GMT +8)**. Challenge Owner(s) and IMDA may extend the deadline of the submission at their discretion. Late submissions on the OIP, or submissions via GeBIZ, will not be considered.