NSIEX+RS 2025
NEGERI SEMBILAN INTERNATIONAL EXPOSITION

HARMONY IN PROGRESS:

INTEGRATING SCIENCE, TECHNOLOGY, AND SOCIAL INNOVATION FOR SUSTAINABLE DEVELOPMENT GOALS

e-Book of Extended Abstract
Negeri Sembilan International (NSIEx) & Research Symposium
2025

YST016 - AIR-DRIVEN CONVEYOR SYSTEM FOR FRICTIONLESS MATERIAL MOVEMENT

Keshwar Sharma[1], Nursyahirah Adnan[*], Nur Syazana Rashidi, and Nasif Mohd Idris

MILA University, School of Engineering and Computing, Department of Mechanical Engineering, 71800 Nilai, Negeri Sembilan

*Corresponding author: nursyahirah.adnan@mila.edu.my

ABSTRACT

Belt conveyor systems, widely employed in material transport, often suffer from excessive energy consumption, maintenance needs, and wear due to friction. These challenges are most acute when transporting delicate and non-standard shapes, raising costs and lowering operational efficiency. This project seeks to develop an air conveyor system which solves these problems. Air conveyors eliminate the need for direct contact between conveyor surfaces and the items being transported, making them particularly helpful for the electronics, pharmaceuticals, and food processing industries which require strict hygiene and system integrity. These industries are also prone to excessive friction and require high maintenance. In this project, an air conveyor system prototype was designed, constructed, and subsequently tested. The prototype utilized an acrylic sheet with holes, plywood, a 700W air blower, a mount for the blower made from 3D printed parts, and some metal brackets. Moreover, tests to determine energy consumption, load, efficiency, and their material specification were conducted. Compared to belt conveyors, air conveyors showed more favourable energy expenditure over a 10-hour operational period. The system reliably transported and supported flat-bottomed items measuring from 5 cm × 5 cm to 16 cm × 16 cm and weighing from 30 grams to 500 grams. The air-driven conveyor system is an example of an innovative system where greater energy efficiency is achieved when compared to conventional systems. Mechanical wear and maintenance costs are reduced alongside improved efficiency and overall effectiveness of the system. The system can be used in material handling systems where its effectiveness and product quality are required while ensuring environmental sustainability.

Keywords – Conveyor, Air-Driven, Frictionless, 3D Printer, Material Handling

INTRODUCTION

Belt conveyors and other mechanical conveyor systems play a significant role in material handling in most industries. However, these systems have a number of tangible limitations. Physical contact between components, materials, and moving parts leads to wear and tear, overheating, and a great deal of mechanical maintenance. All of these limitations lead to operational challenges and raise costs, which coexist with inefficiencies and gaps in sustainability.

For industries handling delicate, irregular, or sensitive materials, constant mechanical contact and friction cause a significant risk of contamination. This eventually deteriorates product quality. Traditional conveyor systems suffer from a large carbon footprint, which

stems from energy-hungry motors and other mechanical components that require a great deal of energy to operate efficiently.

All of these issues call for a meaningful innovation in energy and material handling systems that incorporate low maintenance, frictionless, and cost-effective. This project presents the design of an air-driven conveyor system that utilizes air pressure technology to enable the movement of materials. This system seeks to mitigate the operational ineffectiveness and contact-driven environmental impact of traditional belt systems.

OBJECTIVE

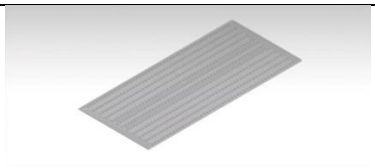
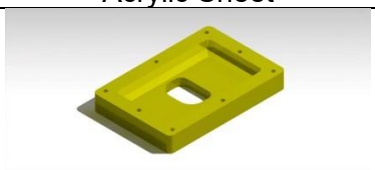
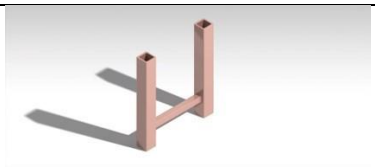
i. To design an air-driven conveyor system for frictionless material movement.
ii. To fabricate the air-driven conveyor prototype utilizing air pressure technology.
iii. To assess the functionality of the prototype under relevant operational constraints.

DESCRIPTION OF THE PROJECT

Conveyor systems, including belt conveyors, have played an important role in various industries for transporting materials. These systems suffer from severe aging and maintenance issues, energy inefficiencies, and wear and tear from contact between parts. Moreover, friction between components and product materials, considering physical contact, results in traditional conveyor systems operating far below their efficiency potential. Certain items are prone to contamination, damage, or other forms of delicate handling due to constant mechanical friction in industrial conveyors. Items undergoing transport are further burdened by considerable environmental strain as a result of traditional conveyor motors driven by energy and fuel-intensive mechanical components. The absence of traditional conveyor systems underscores the need to find a more effective solution. The reduction in friction, maintenance needs, and energy consumption, which leads conveyor belt systems to function at their full potential, becomes critical for optimized productivity. The frictionless transport and damage control objectives of the proposed Air-Driven conveyor systems, which utilize air pressure for material transport, seek to improve traditional conveyor systems. The inefficiencies stemming from traditional technologies can be optimized by shifting focus toward increasing environmental effectiveness. The need for developing a contactless conveyor system using air pressure is because it can greatly change the material handling systems of some industries, which need special handling of items. With the air contactless conveyors are most suitable for handling delicate or fragile items since the technology used needs contactless interaction between the conveyor and the items, minimizing the risk of damage. Contactless conveyors are already used in some critical areas such as electronics, pharmaceuticals, and food processing industries. Moreover, by using air-driven conveyors, the amount of dust and other conventional pollutants is greatly reduced, which increases the cleanliness of the workstation. Advancement of technology in material handling is the response to the challenges modern industries need to face concerning cleanliness, productivity, as well as hygiene, and quality control.

Figure 1: Prototype of air-driven conveyor system

Table 1: Components of the air-driven conveyor system

No.	Component Name	Material	Function
1	 Air Blower	- Electric component - Plastic	To supply air for the conveying system in a high speed and pressure.
2	 Acrylic Sheet	- Poly (methyl methacrylate) - Plastic	Cut with multiple holes to allow air to pass through the holes to maintain uniform exit air for goods to transport.
3	 Blower Mount	- Polylactic Acid (PLA) - 3d printed plastic	Designed and printed to connect the main table and the air blower perpendicular to the acrylic sheet.
4	 Support Legs	- Wood	The main function of the support legs is to lift the conveying surface from the ground and create a space under the sheet to mount the blower.

NOVELTY

The air-driven conveyor system is an innovative system for material handling that uses air propulsion technology to move materials along a conveyor system. This new advancement is beneficial across industries because it improves handling activities with lower risks of contamination through supporting automation integration and pneumatic control. Most distinctive of this system is its capability for contamination-free and damage-proof material transport, which sets a new standard for conveyor systems. Moreover, this system allows

more customization and increases automation for different industries that need transport systems that offer ease and multiple functions. Furthermore, it tries to solve the contamination risks and the malfunction risks posed by the traditional conveyor systems.

CONCLUSION

In conclusion, the air-driven conveyor systems with frictionless material handling represent an innovative advancement in material handling technology. By utilizing air blowers, this system does not use bearings, rollers, or belts, which greatly reduces energy consumption. Furthermore, air blowers, acrylic sheets, and even the 3D printed mounts for the blowers used in this system contribute to gentle and smooth material handling. This gentle system eases the handling of delicate parts. The use of cost-effective and more easily available parts, along with the effectiveness of the air-driven conveyor system, improves operational efficiency and sustainability. This system enhances the functionalities of conventional conveyors. This system shows strong potential for adoption in sectors such as electronics, pharmaceuticals, and food processing, where product integrity is critical.