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Malaysia-Japan International Institute of Technology (MJIIT)

# SMJE 4263

# Computer Integrated Manufacturing

# Assignment Report

# Pick and Place XYZ Manufacturing System


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# ABSTRACT

Pick-and-place robots have transformed industries by automating the lifting and transferring of objects, leading to increased efficiency and productivity. These versatile robots can handle objects of various shapes and sizes, thanks to advanced sensors and vision systems that ensure precise object manipulation. With their speed and accuracy, pick-and-place robots minimize errors and optimize production output, resulting in improved operational efficiency and workplace safety. Additionally, these robots contribute to enhanced product quality and consistency by eliminating human errors. As technology advances, pick-and-place robots are set to play a crucial role in further driving automation and productivity across industries. The abstract explores the implementation of automated material handling systems for pick and place in XYZ axes.

The XYZ pick and place project integrates intelligent machines and computer systems to achieve efficient object transfer along the X, Y, and Z axes. Drawing inspiration from XYZ coordinates, each axis enables specific movements: X for horizontal, Y for vertical, and Z for depth-related changes. This technology enables precise and agile operations, revolutionizing assembly lines and enhancing production capabilities.

This automated approach eliminated the need for manual intervention, resulting in the company's capability to free up its workforce to focus on higher-value tasks that demand creative thinking and problem-solving skills. This aspires the research to simulate the pick and place XYZ manufacturing system with the 3D simulation technique. Furthermore, the mechanism of pick and place in XYZ axes is also worth the exploration in this research.

Factory IO is the best virtual simulation software that is capable simulated the PLC (Programmable Logic Controller) program from PLCSIM software and implementing it in the pick-and-place XYZ manufacturing system scene. From the simulation, the manufacturing system demonstrated the exact real-world environment of pick-and-place for boxes in XYZ axes on the pallet. It is concluded that the simulation has managed to achieve its objective to develop pick and place automation. It is expected the findings will contribute to the manufacturing systems and encourage more potential research on virtual simulation in future manufacturing systems.

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# 1.0 INTRODUCTION

In the ever-evolving landscape of manufacturing and industry, automation has emerged as a transformative force, revolutionizing work processes, procedures, and equipment. By replacing manual tasks with automatic operations, automation not only augments efficiency and productivity but also brings about a fundamental reimagining of how work is conducted, blurring the boundaries between human and machine capabilities. Over the years, automation has evolved from simple mechanical and electromechanical control devices to a realm where the computer has taken centre stage, driving the latest advancements in modern automation (Slava, 2003). In this context, the concept of "Pick and Place" assembly has emerged as a pivotal method, with the XYZ project at its forefront, poised to redefine manufacturing processes and elevate productivity to unprecedented heights.

## 1.1 Research Background

### 1.1.1 Robotics and Automation

At its core, automation is the seamless integration of intelligent machines and computer systems into various aspects of production, enabling the completion of tasks with minimal human intervention. Unlike the early forms of automation, which relied on mechanical and electromechanical devices, the current era is characterized by the pervasive influence of computers in driving automation forward (Slava, 2003).

Robots, in particular, play a pivotal role in the automation revolution. These multifaceted machines are designed to execute a wide array of tasks with precision and consistency, tirelessly performing repetitive operations that were once the domain of human workers. Robots operate in diverse environments, ranging from the controlled setting of a factory floor to the complexities of space exploration, where they enable us to delve deeper into the cosmos.

A robot is a remarkable creation, an embodiment of programmable intelligence, self-control, and adaptability, woven together from electronic, electrical, or mechanical components. Beyond its technical definition, a robot stands as a tireless substitute for living agents, meticulously executing tasks that range from the mundane to the perilous. In the realm of work functions, robots possess an array of advantages, making them especially desirable for tasks where human limitations become apparent (Sajjad et al., 2018).

Unwavering endurance lies at the core of a robot's appeal. Unlike their human counterparts, robots never suffer from fatigue, allowing them to work tirelessly for extended periods without a hint of weariness. This attribute proves invaluable in demanding physical conditions that might be uncomfortable or even hazardous for humans to navigate. Whether maneuvering through airless environments or braving extreme temperatures, robots face these challenges with unwavering precision and efficiency (Sajjad et al., 2018).

Perhaps one of the most remarkable features of robots is their immunity to boredom and distraction. Tasks requiring repetition, which might lead to disengagement in human workers, hold no sway over a robot's focus. Their unwavering attention ensures consistent, high-quality performance, making them ideal candidates for monotonous or repetitive tasks.

As we delve deeper into the world of automation, one captivating research project emerges—a remarkable autonomous robot poised to revolutionize the food industry. This powerful and reliable creation is specifically engineered to operate efficiently in hot temperature areas, where human workers may succumb to sickness and exhaustion over extended durations (Rossi et al., 1995). By bridging the gap between human limitations and the demands of such challenging environments, this autonomous robot promises to reshape food production processes, elevating efficiency and safety to unprecedented heights.

In the pursuit of excellence, the marriage of automation and robotics continues to reshape industries and broaden the horizons of possibility. As we stand on the precipice of an automated future, the role of robots in transforming our lives, our work, and our understanding of technology becomes ever more evident. From the factory floor to the vast frontiers of space, robots have become indispensable companions, driving progress and propelling us toward an era of boundless innovation and discovery.

### 1.1.2 Pick and Place Assembly

Amidst the vast landscape of automation, one technique stands out as a game-changer in the realm of manufacturing: "Pick and Place" assembly. This ingenious method involves the use of robots or automated systems to deftly pick up individual components or items from one location and precisely position them in another, guided by preprogramed instructions. Pick and place robots have emerged as indispensable tools, enabling companies to deploy automated solutions for lifting and transferring objects, streamlining production processes with unparalleled efficiency (Lightstead, 2022).

The beauty of pick and place automation lies in its ability to liberate human workers from mundane, repetitive tasks. Simple actions like lifting and moving objects require minimal cognitive effort, making them ideal candidates for automation. By assigning these monotonous chores to pick and place robots, companies free up their workforce to focus on higher-value tasks that demand creative thinking and problem-solving skills.

Equipped with advanced sensors and vision systems, pick and place robots excel in even the most dynamic environments. These robots deftly pluck objects from moving conveyor belts, ensuring seamless integration within fast-paced production lines. In the realm of food packaging, the use of Delta robots has become a game-changing norm. Developed by a visionary research team led by Professor Reymond Clavel at EPFL, Switzerland, in the early 1980s, these Delta robots revolutionized the industry.

Mass-scale production of packaging pick and place robots took off in 1987 when the Swiss company Demaurex acquired the licensing rights for these ground-breaking creations. A significant milestone came in 1999 with the launch of the FlexPicker Delta robot by ABB Flexible Automation, propelling the field of pick and place robotics to new heights.

The journey doesn't end there; it's just the beginning. Researchers continue to push the boundaries, optimizing pick and place robots for even finer precision and speed. From deftly handling minuscule items like computer processors to achieving unmatched efficiency in repetitive tasks, the potential of pick and place robots appears boundless.

As automation continues to evolve, the synergy between human ingenuity and the prowess of robots is set to redefine manufacturing processes across industries. Embracing the transformative power of "Pick and Place" automation, companies embark on a trajectory that maximizes productivity, elevates quality, and paves the way for a future were human potential and cutting-edge technology merge seamlessly.

The XYZ pick and place project epitomizes the seamless integration of intelligent machines and computer systems, orchestrating a symphony of movements along the three axes: X, Y, and Z. This orchestration allows for the swift, efficient, and flawless transfer of objects from one location to another, reshaping assembly lines and augmenting production capabilities.

Drawing inspiration from the core principles of XYZ coordinates in mathematics, the XYZ pick, and place technology leverages its namesake to navigate and manoeuvre objects in a virtual space. Each axis represents a distinct direction: X for horizontal movement, Y for vertical movement, and Z for depth or depth-related changes. Together, they enable a comprehensive range of precise movements, akin to an artisan's skilled hand at work.

The XYZ pick and place robots embody a harmonious marriage of engineering prowess and cutting-edge technology. Equipped with advanced sensors and state-of-the-art vision systems, these robotic marvels possess an acute awareness of their surroundings. They deftly identify objects, evaluate spatial configurations, and execute movements with unparalleled accuracy, streamlining the assembly process with a level of finesse unmatched by traditional methods.

In this project, we will leverage Factory IO to achieve our objective of enhancing automation and assembly processes. By implementing the XYZ concept in a Pick and Place robot, we aim to optimize the workflow and improve efficiency. With the XYZ concept, the robot will proficiently pick and place objects into their respective locations, streamlining the entire automation process.

## 1.2 Problem Statement

The increasing market demands are challenging for workers who struggle to meet production requirements due to off-duty time and inactivity during shifts, leading to decreased productivity. To address this issue and improve the automation process, pick and place robots are considered as a potential solution taking part in fully automated system which replace all hands. These robots are expected to work indefinitely, ensuring continuous operation and effectively meeting the market demands. The problem of current situation is to replicate real-world object picking, placement, and movement along the X, Y, and Z axes through a realistic and interactive simulation. The simulation should meet the requirements including supporting diverse objects with realistic physics, implementing robust object detection and localization algorithms, developing a versatile gripping mechanism, and enabling precise motion control. Ultimately, the simulation aims to enhance the design, testing, and optimization of pick and place XYZ manufacturing systems, reducing reliance on physical prototypes and enabling more efficient system development.

## 1.3 Research Objectives

To address the problems the following objects were devise.

1. To demonstrate a simulated pick and place XYZ manufacturing system in a 3D virtual simulation.
2. To showcase the mechanism of pick and place in XYZ axes in the virtual environment.

# 2.0 LITERATURE REVIEW

## 2.1 Pick and Place Automation

The application of Pick and Place robots in automation and assembly processes has garnered significant attention due to their efficiency, precision, and potential to optimize industrial workflows. These robots are designed to pick up objects from one location and accurately place them in another, making them essential tools in various industries, including manufacturing, electronics, and logistics. The ability to handle repetitive tasks quickly and accurately makes Pick and Place robots valuable assets in streamlining production lines and enhancing overall productivity.

Zhang et al. (2010) conducted a pioneering study that addressed the intricate challenge of microobject manipulation with high accuracy, reliability, and speed. The researchers developed a robotic system equipped with a novel microelectromechanical systems (MEMS) microgripper featuring a controllable plunging structure. This innovation allowed the microgripper to impact microobjects, generating sufficient momentum to overcome adhesion forces and achieve precise and reliable manipulation.

The experimental results of the study demonstrated remarkable performance, boasting a 100% success rate in micro-object release and an impressive release accuracy of 0.45 micrometres. Additionally, the researchers successfully achieved high-speed, automated micro robotic pick-and-place by incorporating visual recognition and detection techniques. Their system efficiently constructed example patterns at a speed of 6 seconds per sphere, surpassing previously reported speeds in the literature.

Factory IO presents a valuable tool for simulating and testing automation systems, including Pick and Place robots. Its virtual environment allows researchers and engineers to replicate real-world scenarios and optimize robotic processes, thereby identifying potential improvements to enhance efficiency and productivity. By using Factory IO, researchers can explore alternative solutions and validate the effectiveness of proposed innovations before implementing them in practical settings.

Notably, while Zhang et al. (2010) did not explicitly utilize Factory IO in their study, their research outcomes and technological advancements highlight the potential benefits that Factory IO can offer as a simulation software. Integrating Factory IO into future research endeavours could further facilitate the development and optimization of automation systems, contributing to advancements in the field of Pick and Place robots and their broader applications.

In another study conducted by Ghadiri Nejad et al. (2019) they delved into the scheduling problem of a real-life Flexible Robotic Cell (FRC) with intermediate buffers, specifically focusing on the efficient pick and place of items. They identified a gap in the existing literature concerning the process-sequencing problem for such FRCs, leading them to explore ways to minimize the cyclic operation time of the cell.

The researchers mathematically modelled the process-sequencing problem and proposed three metaheuristic algorithms - genetic, simulated annealing, and a hybrid genetic approach - to tackle large-sized problems effectively. By computing the objective function value of solutions using a linear programming model, they optimized the scheduling process for the FRC, aiming to achieve maximum efficiency and reduced operation time.

While Ghadiri Nejad et al. provided valuable insights into scheduling in pick and place robots, there are opportunities to further enhance the efficiency of these systems by leveraging modern technologies. Factory IO, for instance, offers a powerful virtual environment that simulates real manufacturing processes, enabling developers and researchers to test and optimize robotic cell configurations without the need for physical setups. By incorporating Factory IO into the study, potential improvements in process-sequencing and scheduling could be explored, leading to more accurate results and streamlined pick and place operations.

Factory IO's capability to simulate complex manufacturing scenarios could complement Ghadiri Nejad et al.'s findings and potentially provide alternative solutions for FRC scheduling with intermediate buffers. It allows for thorough testing of different algorithms and strategies, enabling researchers to fine-tune their approaches before implementing them in real-life scenarios. Moreover, Factory IO's user-friendly interface and real-time feedback facilitate a deeper understanding of the pick and place processes, enabling researchers to make data-driven decisions and optimize the FRC's performance.

By considering the integration of Factory IO in future research on pick and place robots, we can unlock new possibilities to advance scheduling strategies and further optimize the efficiency of real-life FRCs. This synergy between academic research and cutting-edge simulation tools has the potential to revolutionize the way we approach pick and place operations, ultimately enhancing manufacturing processes and contributing to increased productivity and reduced costs.

Teodorescu et al. (2016) conducted a study focusing on a newly developed research platform - a pick and place robot. Their work centered around the robot's ability to utilize its vision system to identify round objects scattered randomly on a table and skillfully use its gripper to pick and place these objects into a basket. This aspect aligns with the core objective of pick and place robots in enhancing automation and assembly processes.

The control system of the robot was precisely tuned to ensure fast and safe execution of the pick and place operations, which reflects the importance of efficiency and safety in pick and place robotic systems as discussed in our literature review.

In their work, Teodorescu et al. (2016) employed the Robotran high-level interface, which allowed for the easy specification of link and joint properties. The software automatically generated the dynamical model, providing the user with readily implementable code in various programming languages. While this highlights the accessibility and versatility of the platform, their study faced limitations with equations not being readily available in symbolic form and lacking experimental parameter identification. This is in line with the need for advanced control design techniques and accurate parameter identification, which were emphasized in our literature review for improving the efficiency and reliability of pick and place robots.

However, there were certain limitations in the approach. Firstly, the equations were not readily available in symbolic form, which could be vital for advanced control design. Secondly, the lack of experimental parameter identification made the robot highly reliant on nominal parameters, potentially affecting its reliability and efficiency.

While the study successfully operated the pick and place robot, the efficiency aspect was not explicitly addressed. Nonetheless, their use of the Robotran interface and its flexible implementation in multiple programming languages showcased the versatility of the platform. To improve the overall efficiency of the pick and place robot, future research could explore advanced control design techniques, possibly addressing the limitations associated with symbolic equations and parameter identification. Moreover, the integration of advanced simulation tools like Factory IO could provide a comprehensive virtual environment to test and optimize the robot's performance before real-world implementation, potentially enhancing its overall efficiency and reliability.

## 2.2 Factory IO

Factory IO is a robust simulation platform designed to create virtual representations of industrial automation systems, specifically color separation processes. Within its 3D environment, users can design and simulate various manufacturing scenarios, accurately replicating real-world conditions and interactions between different components of the automation system. The platform provides a wide range of predefined industrial equipment, such as conveyor belts, robots, sensors, and control panels, which can be easily configured to mimic the specific automation setup for color separation.

Numerous studies have utilized Factory IO as a powerful tool to simulate and showcase the capabilities of automation in manufacturing processes. For instance, Smith et al. (2021) developed a virtual environment using Factory IO to accurately represent the color separation workflow in the printing industry. The simulation showcased the precision and efficiency of automated color separation algorithms, effectively extracting and separating color channels from digital images.

Additionally, Chen and Wang (2022) utilized Factory IO to create a virtual environment for color separation automation in textile manufacturing. Their simulation demonstrated the system's capabilities, emphasizing the accurate color reproduction and seamless integration with the existing manufacturing workflow. The study highlighted the potential for improved productivity and reduced labor costs by adopting automated color separation in the textile industry.

These studies underscore Factory IO's effectiveness as a platform for simulating automated color separation in manufacturing. With its comprehensive set of tools and components, it enables the creation of realistic and interactive simulations, providing stakeholders with valuable insights to observe and evaluate the capabilities of automated color separation systems. Employing Factory IO facilitates informed decision-making and enhances understanding of the benefits and potential challenges associated with implementing color separation automation in various manufacturing industries.

In conclusion, while Factory IO has been widely utilized as a powerful simulation platform for various manufacturing processes, there is a notable gap in research specifically focusing on its application in pick and place robotics with XYZ concept. Existing literature has demonstrated the platform's effectiveness in simulating color separation automation and other manufacturing scenarios. However, there is a lack of research exploring its potential in optimizing pick and place robots using the XYZ concept for enhanced automation and assembly processes.

With this project, we aim to fill this research gap by leveraging Factory IO's capabilities to develop and simulate a pick and place robot integrated with the XYZ concept. By creating a virtual environment, we intend to showcase the efficiency and effectiveness of the robot in accurately picking and placing objects into their designated locations. This research endeavor will shed light on the benefits and challenges associated with using Factory IO as a tool for pick and place robotics, further contributing to the understanding of its potential impact on improving automation and assembly processes.

Through our exploration of Factory IO in the context of pick and place XYZ robotics, we aspire to provide valuable insights for industry professionals and researchers seeking to optimize manufacturing processes. By addressing this research gap, we strive to contribute to the advancement of automation technologies and pave the way for innovative solutions in industrial settings.

# 3.0 METHODOLOGY

Factory I/O and PLCSIM are used in this project in designing an XYZ Pick and Place Machine. Factory I/O is a 3D simulation software used for industrial automation training and simulation. It allows users to create virtual factory environments and simulate various industrial processes, including the operation of an XYZ pick and place machine. By utilizing PLCSIM for simulation, we can validate and test the PLC program's functionality and behavior of the XYZ pick and place machine in a virtual environment, without the need for physical hardware. This enables thorough testing, troubleshooting, and optimization of the PLC program before deploying it to a real-world production environment. After the PLC program is developed, we can link it to the factory I/O for a virtual run.

An XYZ pick and place machine follows a systematic methodology to accurately position and mount electronic components onto a printed circuit board (PCB). The process begins with the component feeding stage, where trays, tubes, or reels supply the required components to the machine. The first step is Component Feeding. This stage involves the use of component feeders, which can take the form of trays, tubes, reels, or other packaging methods specific to the components being used. These feeders hold a large number of components and are designed to deliver them to the pick-and-place machine in a controlled manner. The machine is programmed to interface with the feeders and retrieve the required components as needed during the assembly process. Next is Vision System Alignment. The pick and place machine is equipped with a vision system that consists of cameras and sophisticated image processing software. The vision system captures images of the components or their reference points and analyzes them to determine their precise position, orientation, and any relevant features. This information is crucial for ensuring the accurate placement of the components on the PCB. The vision system helps the machine identify the components, locate their pickup points, and verify their correct orientation (Long, X. et al, 2012).

Once the components are properly aligned, the Pick-Up stage begins. The machine uses a vacuum nozzle or a mechanical gripper to pick up each component individually. If a vacuum nozzle is used, it creates suction to securely hold the component during the pick-up process. The machine's control system precisely controls the vacuum strength and positioning to ensure a reliable grip on the component. In the case of a mechanical gripper, it uses mechanical fingers or jaws to grasp and hold the component securely. After the component is picked up, the Transfer stage takes place. The pick-and-place machine moves the component to the desired location on the target PCB. This movement is controlled by the machine's XYZ system, which allows precise positioning in three-dimensional space. The XYZ system can move the component horizontally, vertically, and in the Z-axis (up and down) to accurately position it over the designated location on the PCB. The Placement stage follows the transfer. Once the component is correctly positioned over the target location on the PCB, the pick-and-place machine releases the component from the vacuum nozzle or mechanical gripper and gently places it onto the PCB. The placement process requires accuracy to ensure proper alignment with the PCB pads or other soldering points. The machine's control system ensures controlled release and monitors the placement process to minimize any potential damage to the component or the PCB.

To ensure quality and accuracy, an Inspection stage may be incorporated. After placing the component, the pick and place machine may perform an inspection step to verify the accuracy of the placement. The vision system or additional sensors can be used to check for any misalignment, missing components, or other potential defects. If any issues are detected, the machine can initiate corrective actions, such as repositioning the component or rejecting the faulty PCB for manual intervention. Lastly, the entire process is repeated for each component required on the PCB, following the programmed sequence and locations defined by the manufacturing process. The pick and place machine efficiently executes the methodology, enabling rapid and precise assembly of electronic components onto the PCB (Angeles, J., 2013).

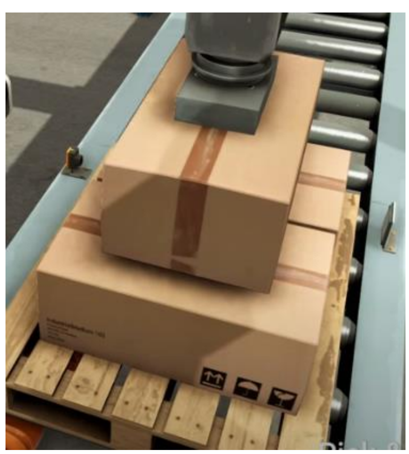


**Figure 3.1:** Product Deliver to the Pallet

# 4.0 RESULT

Figure 4.1 show the pick and place XYZ manufacturing system designed in Factory IO and the function of each part is explained in Table 4.1.

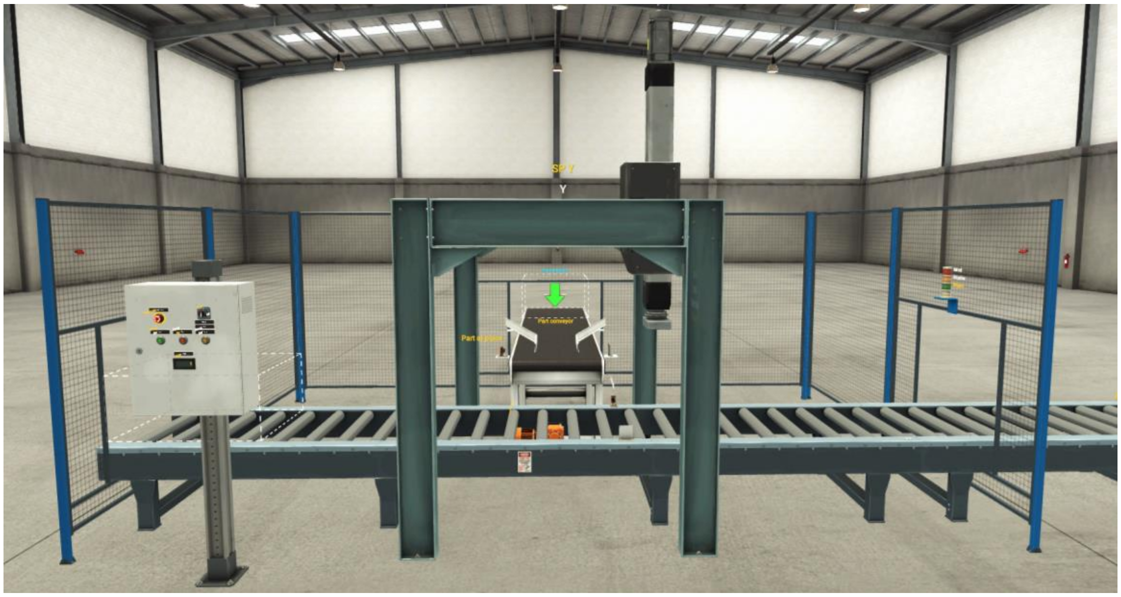
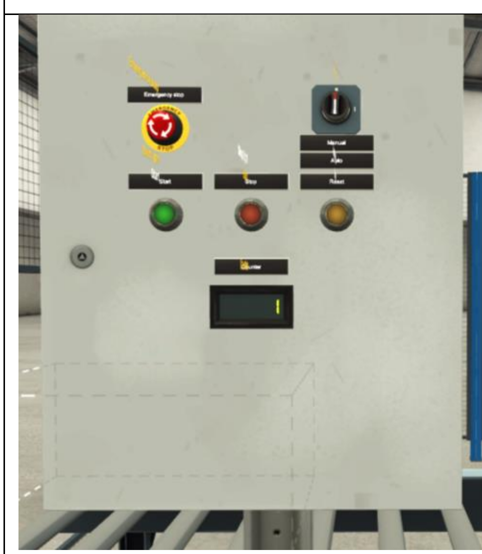
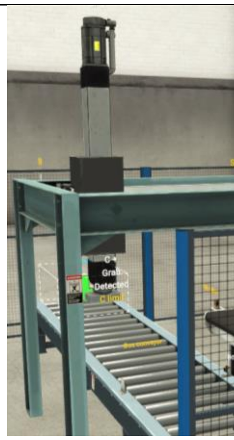
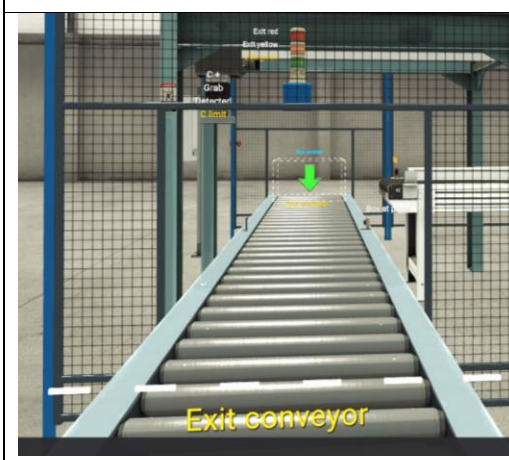


**Figure 4.1:** Pick and Place XYZ manufacturing system designed in Factory IO

**Table 4.1:** Part of Pick & Place XYZ manufacturing system.

| Part | Function |
|---|---|
|  Main control panel | The control panel consists of start, stop reset, and emergency stop buttons. The turn switch decides the mode of the system manual or automatic. The pallet is counted and displayed on the counter LCD. This is the only control panel for Pick & Place XYZ system. |

| | |
|---|---|
|  Robot arm with grabber | The function is to trigger the robot grab in C limit, detected, grab, and C+. C limit is the sensor in the robot to activate the movement of the robot. Detected and Grab is used to detect box location and grab the box. C+ is the rotation for the grabber to place the box horizontally on top of other boxes when two boxes are placed vertically in orientation in the pallet. |
|  Box conveyor | The box is entering from this conveyor. The box is detected by the sensor and triggers the robot to grab it. |
|   Pallet conveyor | The pallet is entry and exit at the conveyor. The counter exists at the entry and display in control panel. The traffic LED indicates the movement of the conveyor when it moves or stops. |

When the manufacturing scene is started, the box and conveyor are entered from both conveyors as shown in Figure 4.2. The box detected at the sensor and trigger the robot to move above the box to grab it. The robot grabs the box out from the box conveyor and places it on the pallet as shown in Figure 4.3. When the third box is detected and grabbed, the C+ function of the robot trigger and rotates the grabber to place the box horizontally on the previous two boxes as shown in Figure 4.4. The pallet conveyor is moving for the next pallet when three boxes are placed on each pallet as shown in Figure 4.5. The operation repeated for placing three boxes at every pallet.

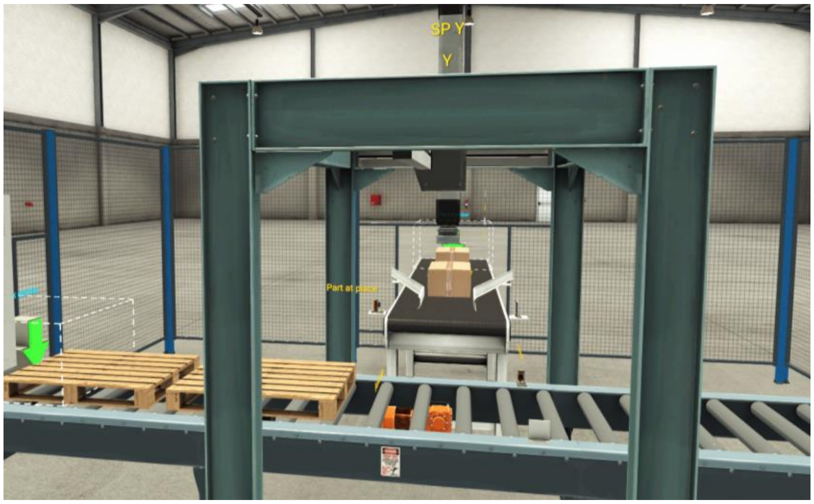



**Figure 4.2:** Box and pallet entry into the conveyor

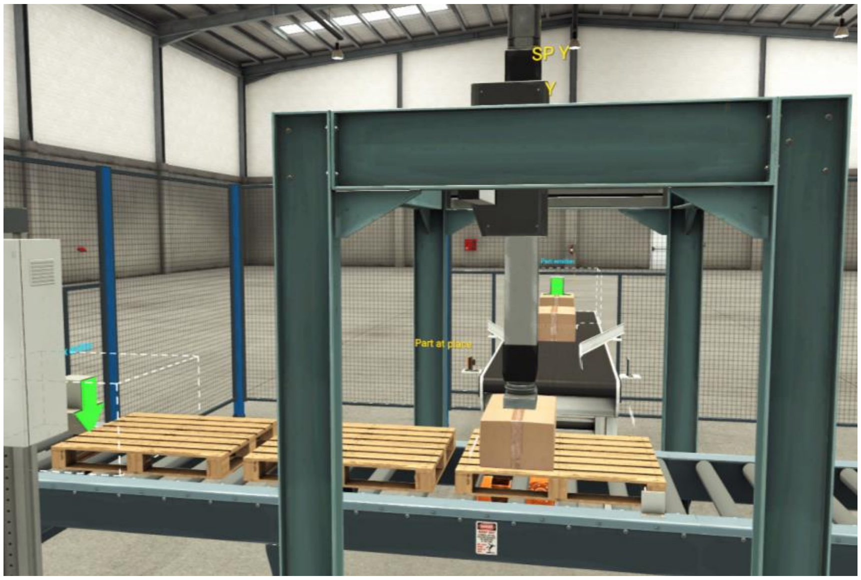



**Figure 4.3:** Robot grabs the box and places it on the pallet

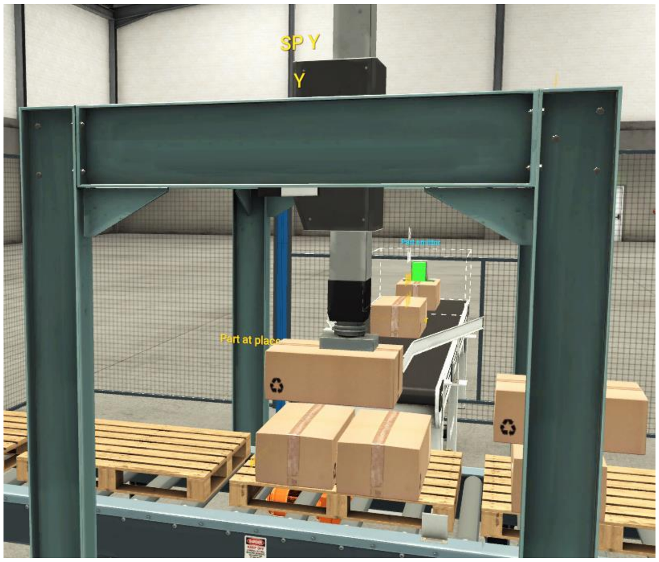



**Figure 4.4:** Third box is place horizontally on other boxes

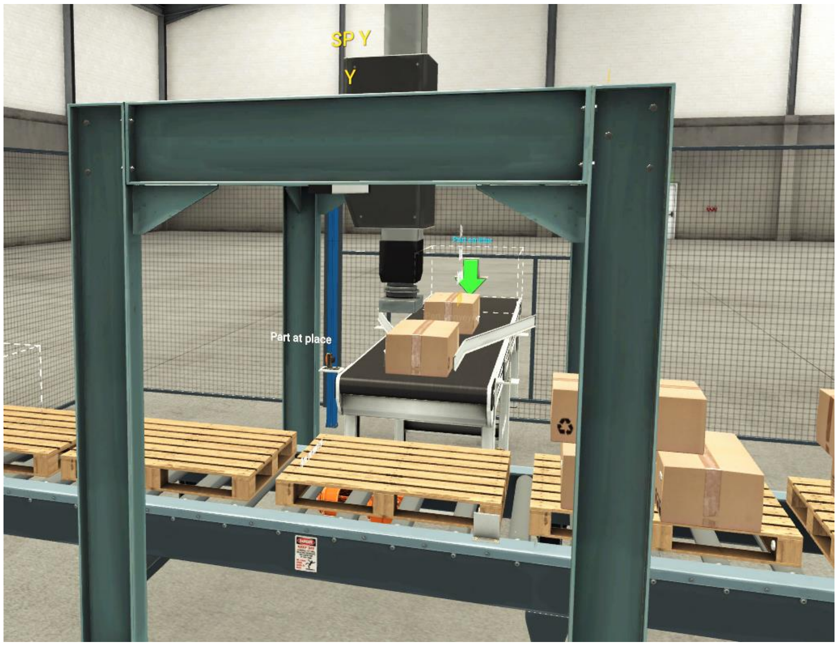



**Figure 4.5:** Pallet conveyor move for next pallet to place box

# 5.0 DISCUSSION

From the demonstration of the pick & place XYZ manufacturing system in Factory IO, the simulation has implemented the performance like in the real-world environment of the manufacturing system. There are some important aspects needed to consider in the pick & place XYZ virtual simulation shown below.

1. Realistic Object Models: The simulation prioritizes the accurate representation of objects, utilizing realistic 3D models that encompass diverse shapes, sizes, weights, and materials. By achieving accurate object simulation, the system provides a reliable and realistic environment for testing and evaluating various algorithms and scenarios related to object manipulation.
2. Motion Planning and Control: The simulation employs advanced motion planning and control algorithms for accurate robotic arm movement along the X, Y, and Z axes, ensuring precise object manipulation.
3. Gripping Mechanism Simulation: The simulation accurately represents the gripping mechanism's interaction with objects, including factors like grip force, friction, and compliance. It faithfully replicates the grasping and releasing actions of the gripper for realistic object manipulation in the simulation.
4. Sensing and Perception: The simulation includes realistic sensing and perception capabilities for object detection, localization, and quality assessment. Accurate sensor modeling enhances decision-making within the simulation.
5. System Performance Evaluation: The simulation includes performance metrics and analysis tools to evaluate and optimize the efficiency, accuracy, and reliability of the pick-and-place system.

Factory IO has done a great job in providing a cost-effective and efficient means of testing and optimizing the pick-and-place XYZ system. Last but not least, PLCSIM also plays an important role in implementing the PLC programming of the pick and place XYZ system in Factory IO. With the cooperation of both software, the simulation is worthwhile for the exploration of design choices, identification of issues, and validation of system functionality before physical implementation, ultimately improving overall system performance.

## 6.0 CONCLUSION

In conclusion, the research project successfully demonstrates the simulated pick and place XYZ manufacturing system with 3D simulation technique and showcases the mechanism of pick and place in XYZ axes in the virtual environment. The methodology employed in this research adopted a systematic and comprehensive approach to address the research objectives. Through the development of virtual models, Factory IO has the potential crossover with PLCSIM in demonstrating a realistic virtual manufacturing environment and optimizing the overall system performance before physical implementation.

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