IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

DIGITAL TWIN TECHNOLOGY IN AUTOMATION

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Abstract: *A digital twin is a virtual representation of a physical entity, replicating its data model, behavior, and interactions with other physical entities. Digital twins serve as digital copies of the physical object or process they represent, allowing for near real-time monitoring and evaluation without the need for physical proximity. The ongoing technological advancements across industries, along with the imperative to quickly respond to evolving customer requirements, demand logistics processes to be equally responsive, sometimes even faster, to changing market conditions. The concept of Industry 4.0, with its modern techniques and tools, facilitates the utilization of digital twins in modeling and simulating logistics processes, providing not only financial benefits but also supporting decision- making when selecting automation options for logistics processes. When developing a digital twin, it's essential to prioritize its effectiveness, ensuring it remains as user-friendly as its intended purpose allows. The selection of an automation approach necessitates a thorough assessment of its implementation effects, and modeling and simulating processes are ideal for this purpose, as they don't entail significant costs and labor-intensive efforts.*

Index Terms – *Digital Twin, Virtual Representation, Real Time Monitoring, System Integration.*

I. INTRODUCTION

In an era marked by relentless technological advancement and an ever-accelerating pace of change, industries across the spectrum are compelled to re-evaluate and revolutionize their approaches to manufacturing and operations. At the forefront of this transformation lies Digital Twin Technology, an innovative concept that has emerged as a potent catalyst for enhancing efficiency, reducing downtime, and optimizing processes in the realm of process automation. The digital twin concept is rooted in the creation of a virtual counterpart that mirrors a physical entity, be it a machine, a product, or an entire system. This digital replica is more than a mere simulacrum;it encapsulates a wealth of data, behavioural characteristics, and real-time functionalities. Digital twins serve as dynamic mirrors, enabling organizations to monitor, analyse, and even manipulate physical assets and processes remotely and with unprecedented precision. In the realm of modern logistics and supply chain management, efficiency, accuracy, and adaptability are paramount. The challenges of sorting and distribution processes are complex and ever-evolving, with the need for rapid response to shifting market dynamics, customer demands, andoperational variables. Enter Digital Twin Technology—a game-changing innovation that is revolutionizing the way sorting and distribution machines operate.

Figure 1*: Digital Twin Technology.*

Digital Twin Technology, a concept initially rooted in manufacturing, has rapidly expanded its footprint into varioussectors, including logistics. It offers a virtual replication of physical sorting and distribution systems, allowing real- world machines and processes to be mirrored in a digital realm. This virtual counterpart is not merely a static representation; it is a dynamic, data-rich entity that can mimic, monitor, and optimize the behavior of its physical counterpart in real time. The integration of Digital Twin Technology into sorting and distribution machines ushers in a new era of efficiency, resilience, and adaptability. This innovation enhances the capacity to sort, organize, and distribute goods with unprecedented precision and agility. Sorting and distribution operations are no longer limited by the physical constraints of the equipment; they are augmented by the power of real-time data analysis, predictive maintenance, and responsive decision-making. In this paper, we delve into the trans-formative potential of Digital TwinTechnology for *sorting and distribution machines. We explore its foundational principles, its evolution within the logistics domain, and its tangible benefits for businesses seeking to optimize their supply chain operations.*

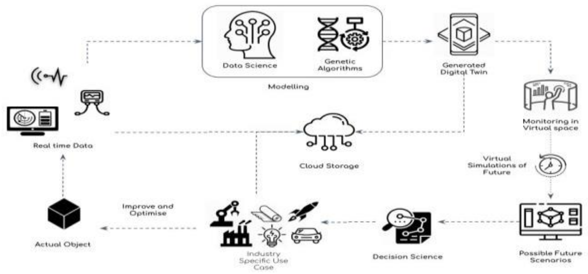

Figure 2*: Workflow of Digital Twin.*

As we embark on this journey through the world of digital twins in sorting and distribution, we will uncover how this technology is reshaping the landscape of logistics, ushering in an era of smarter, more efficient, and more adaptive sorting and distribution processes. Digital twin is a virtual entity supported by AI (Artificial Intelligence), IOT (Internet of Things) and abundance of data. This helps in creating a digital representation of the physical object in consideration. The representation can then be simulated in different environments according to the requirements to conclude the final state of the physical object. Through the simulation many insights can be drawn about the object. As can be seen in the diagram below, real time data inputs of the actual objects helps in creating a digital twin, which is then monitored and simulated to understand insights to make business decisions.Today, technological advancements have enabled organisations to utilise the benefits offered by Digital Twins in multiple domains. The advent of Industry 4.0 and the availability of technical resources has not only helped advancing the usage of Digital twins but has also enabled progress and betterment in the industries associated that utilise Digital twins. Given below are few industries that can benefit heavily from this booming technology.

1. Digital Twin in Steel Industry

Steel manufacturing is a detailed process that has to fit the end product to a wide variety of user needs and uses. An imperative step in the production of steel products is the testing of quality as it often varies across the plethora of its utilities. In order to effectively test the designs and compositions of the end products, a key aid would be the utilisation of Digital Twins. A virtual copy of the real-world project can subject it to a wide range of conditions to confirm the products' durability and sustainability .One of the major concerns in the manufacturing of steel productsis rusting. In this case a digital twin of the product can be simulated to test it in different weather conditions with varying alloy compositions to arrive at the most suitable one. Another area of soaring interest is the utilisation of digital twins to test the benefits of utilising certain metals in steel alloys for kitchenware.
The simulations can provide health conscious customers a detailed analysis of the benefits of using particular steel products making it more appealing to the customers and boosting sales. The utilisation of steel in construction of large structures has been a standard for a long time. However, understanding the effects on the strength of utilizing particular steel varieties has always required detailed prototyping and utilisation of expensive resources. Industry 4.0 and especially Digital twin simulations have been able to provide a perfect platform to experiment multiple ratios of carbon in steel to arrive at suitable products. In addition to understanding the strength of the materials, the use of digital twins can also assist in determining the optimal amount of materials to be used. It can simulate under extreme conditions and come up with additions to the composition to help optimize the requirements while curtailing excessive costs.

2. Digital Twin in E-Commerce Industry

Many e-commerce platforms have been able to achieve a customized shopping experience for a specific demographic. The recommendations are provided based on search history of the specific demographic. For example:Females between the age of 18-29 might prefer to buy a certain style of dress. The use of digital twins can bring a disruption in the current shopping experience by giving recommendations to every customer based on their own likings. By bringing into consideration their search history (in and out of the platform), the kind of products they haveviewed, added in cart, products in their wish-list, based on the products they have purchased in the past, a very personalized shopping experience can be provided to the customer. Interlinking categories to make recommendations, e.g. suggest merchandise based on the shows they watch or books they read, can be used too. By showing the customer exactly what he/she might like, the conversion rate can be improved drastically.

3. Digital Twin in Production & Manufacturing Industry

Large organizations often have huge stockpiles of the product warehouses. However these stockpiles are concentrated in certain regions and their effective transport to the regions of necessity is a monumental task. These supply chains often are highly coordinated yet they are stressed and lead to failures when an unprecedented event occurs. Digital twins can help simulate these sudden rises and drops in supply, in order to meet the production demands and make the whole process seamless.

4. Digital Twin in Industrial Equipment

With the introduction of robots in the industrial process several organisations are aiming to produce and create custom equipment to suit the customers needs. The designing of these equipment always coincides with the utilisation of expensive resources to generate prototypes and test them in the field. With a digital twin of the equipment, we are able to identify the areas of improvements for a particular equipment and customise it to suit the needs of the customer. Equipment manufacturers by utilising the DT can successfully iterate through multiple prototypes required in order to finally arrive at a suitable end product. At the same time the simulated environment of the digital twin would also be able to provide an understanding of how the equipment performs over time and the *necessary maintenance and upgrades needed to be done in order to optimize the output of the industrial process.*

Industrial processes involving heavy equipment often involve the synchronous working of multiple equipment simultaneously. These equipment often are designed to act individually however for many situations they are pairedup to increase the output. In order to decide the best combination of equipment that would enhance the industrial outputs digital twin technology can be utilised. With the help of digital twins multiple combinations of the equipmentcan be experimented on till an optimum combination can be achieved. In addition to finding an optimum combination,we would also be able to understand the future costs and outputs and decide which equipment systems work best inthe long run.

5. Digital Twin in Food Industry

High Quality Production is imperative to maintain brand value. Many times discrepancies due to manual or machineryerrors result in the quality of the produced batch to be low or the shelf life of the product to be low. In such scenarios, a small change in the parameters of electric motors, current, leads to poor quality of production. The expertise knowledge of being able to judge the quality of produced batch can be determined only after running the production process in real time and then conducting quality tests. Using digital twins of physical assets, simulations of various parameters using real time data will act as a monitoring and precautionary tool to avoid the poor quality batch processing of products. Every simulation generated will be tested in real conditions to constantly receive feedback and learn better. Initially it can be tested on the virtual asset to predict the condition based on simulations in a virtual environment. Once predicted, it is then tested in real time conditions. It can also be used to identify patterns in production that were simulated for early recommendation. This would aid the process by saving overhead charges as well as overall optimization.

One more example of using digital twins in the food industry is personalized recommendation of recipes. Today Artificial Intelligence technology is able to identify the contents of the products. Identifying which recipe is the best purely depends on the ratings received by the customer or by any specific feedback mechanism. Using the digital twin of the product recipes, simulations can help us provide enhanced recipes and rate it based on the feedback received from the chefs, customers.

6. Digital Twin in Textile Industry

With the growing popularity of fast fashion and the multitudes of options available for customers in the textile industry there is a huge scope for the utilization of Digital twins in this domain. Digital twins can be utilised in multiple ways, they can be utilised to come up with new styles and designs by taking an input of particular clothing style, patterns and colours. Secondly it can also understand a person's specific choices and come up with a style unique to the person. This can also be simulated in a specific demographic to understand its acceptance, and analyse what sortof clothing is currently trending in the market.

Clothes are generally produced in bulk with a minimal analysis on the quantity and distribution of the end product. This often leads to a drop in prices if overproduced or a gap in the supply demand margins often causing companies to lose out on increasing revenue. If the same decision is aided by the use of Digital twins, an accurate estimate of the quantity and distribution can be made using a variety of inputs. Simulated based on conditions and choices of the public the requirements can be analysed to make the production process effective. This quantity can help reduce theshop residuals and at the same time aim at optimizing raw material usage.
As mentioned for the E-commerce industry, purchasing experience can be enhanced using digital twins. This can also be used to perfectly choose outfits for people on a daily basis, this will depend on the mood, month, weather conditions. location, schedule of the person, comfort and also the choice of the individual.

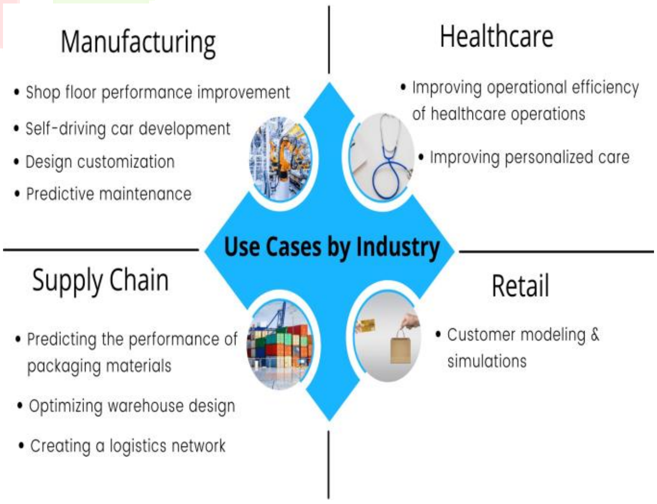

***Figure 3**: Use Cases by Industry.*

II. DIGITAL TWIN FOR SORTING AND DISTRIBUTION

Automatic sorting systems are the core equipment of modern distribution centers and are an essential part of auto-mated logistics systems. Compared to manual sorting, automatic sorting systems enable efficient and accurate sorting of express shipments through automated control and information recognition technologies, which can reducethe risk of loss of express shipments, enhance shipment safety and reduce labor costs. There are many different types of automated sorting systems in use in the courier sector. However, cross -belt automated sorting systems are the most popular type of sorting system used in the courier sector, with the most mature technology and the broadest range of applications com-pared to other types of sorting systems. However, the widespread use of cross-belt sortingsystems also comes with new challenges. People play an essential role in some of the key aspects of cross-belt sorting systems. There are currently no proven intelligent alternatives to human beings for unpacking, supplying, collecting and manual complement code in the cross-belt sorting process.

The complexity of the work environment in the sorting center, such as equipment noise, light pollution from industrial cameras and the "cool winter and warm summer" conditions in the site, is not conducive to long hours of continuouswork from a "human -centred" perspective. In addition, there are several e-commerce sales periods throughout the year, where the surge in the volume of express shipments brings about high-intensity work, which further affects the health of operators. The workers' health is also affected by the high intensity of work caused by the surge in the volume of express shipments. In 2021 the European Union put forward a new concept for the development of Industry 5.0, which emphasizes the importance of placing the interests of workers at the heart of the operational process. In this context, the distribution center is changing towards a human-centered, intelligent, and green direction. Harmonious integration and safe interaction between man and machine are crucial. The human being is the most dynamic and energetic element of the system.

A. Digital Twin Framework for Manufacturing.

A new ISO standard, ISO 23247 - Digital twin Manufacturing Framework, has recently been published to facilitate the implementation of digital twins in manufacturing. The standard provides guidelines for analyzing modeling requirements, defining scope and objectives, and promoting the use of common terminology and generic reference architecture. The reference architecture includes a reference model with domains and entities. There are fourdomains, and each has a logical group of tasks and functions, which are performed by functional entities. Figure shows the entity-based reference model and an illustration of the four domains and their interactions (ISO 2020). Eachdomain is briefed as follows.

- *observable manufacturing domain: contains the Observable Manufacturing Elements (OMEs), including personnel, which are the physical elements that provide an environment for digital twins.*
- *device communication domain: links OMEs to their digital twins for synchronization by monitoring and* collecting data from sensor devices in the observable manufacturing domain, and controls and actuatesOMEs.
- *digital twin domain: responsible for overall operation and management of digital twins, hosts applications andservices such as data analytic, simulation, and optimization to enable provisioning, monitoring, modeling, andsynchronization. It also interacts with other digital twin entities.*
- *user domain: a user can be a human, a device, an application, or a system that uses applications and servicesprovided by the digital twin domain.*

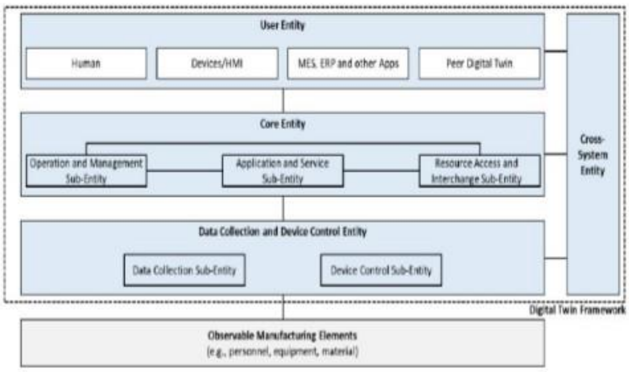

***Figure 4**: Functional view of digital twin reference model for manufacturing.*

In Figure 4, the digital twins can be created based on the Digital Twin Framework depicted within the dotted line. The framework supports the applications of IoT infrastructure for data collection, communication protocols for data transmission, and information flows between entities of different domains, i.e., OMEs, Data Collection and Device Control, Digital Twin Core, and User layers. To identify requirements for digital twin development, these various aspects need to be considered and followed.

B. Automation Studio

A single uniform programming tool for every aspect of an automation project minimizes training needs, solidifies overall integration, and eliminates communication problems between engineering disciplines. Save time and money by starting software development before the hardware is completed, reusing software modules across multiple projects, validating functionality via simulation and carrying out commissioning module by module.

***Figure 5**: Automation Studio Software by B&R Industrial Automation.*

The modular architecture and structure of the programming environment supports your daily programming workflowand gives your developers more capacity for the core competencies of the machine. The integrated and standardized IEC 61131-3 languages and perfect ANSI C integration in the IEC world ensure that new users will feel right at home. Other integrated features such as Smart Edit and editor bookmarks make operation easier while boosting productivity at the same time. All languages can access the same data types and use the same libraries and variables. In addition, Automation Studio supports simple and secure programming. Simple and complete programming through Modular architecture and structuring of subprograms into tasks with different priorities. Structuring of subprograms into the initialization and cyclic routines, each with a different programming language. Structuring of programs using IEC actions in all IEC languages and Automation Basic. Division of global and local variables. Any combination of languages possible in the project and time classes. Dependencies with hardware and libraries managed by Automation Studio. Integrated IEC 61131-3 languages, CFC and ANSI C. Libraries can be implemented in any language – IEC. Standard libraries and expanded B&R libraries.Comfort functions in the programming language .

The visualization system integrated in Automation Studio is an effective tool that can be used to create line displays or control integrated or remote XGA displays with keys and/or touch screens. Integration of the visualization system in the control means that the communication times that are normally required for remote visualization systems are nolonger an issue.Automation Studio provides a wide selection of diagnostic tools for reading system information and for optimizing the system. Using the System Diagnostics Manager, extensive information about the target system can be read using standard Web access. In Automation Studio, a fieldbus device is added to the corresponding fieldbus interface and configured like an I/O module.The import function provides a uniform interface for importing device descriptions from the various providers (GSD, EDS, etc.).An integral component of Automation Studio is the real-timeoperating system, the software kernel that allows applications to run on a target system. This guarantees the highest possible performance for the hardware being used.

III. A MANUFACTURING PROCESS EXAMPLE

Digital twins are designed to model complicated assets or processes that interact in many ways with their environments for which it is difficult to predict outcomes over an entire product life cycle.8 Indeed, digital twins may be created in a wide variety of contexts to serve different objectives. For example, digital twins are sometimesused to simulate specific complex deployed assets such as jet engines and large mining trucks in order to monitorand evaluate wear and tear and specific kinds of stress as the asset is used in the field. Such digital twins may yieldimportant insights that could affect future asset design. A digital twin of a wind farm may uncover insights into operational inefficiencies. Other examples of deployed asset-specific digital twins abound . As insightful as digitaltwins of specific deployed assets may be, the digital twin of the manufacturing process appears to offer an especially powerful and compelling application. he digital twin serves as a virtual replica of what is actually happening on the factory floor in near-real time. Thousands of sensors distributed throughout the physical manufacturing process collectively capture data along a wide array of dimensions: from behavioral characteristicsof the productive machinery and works in progress (thickness, color qualities, hardness, torque, speeds, and so on) to environmental conditions within the factory itself.

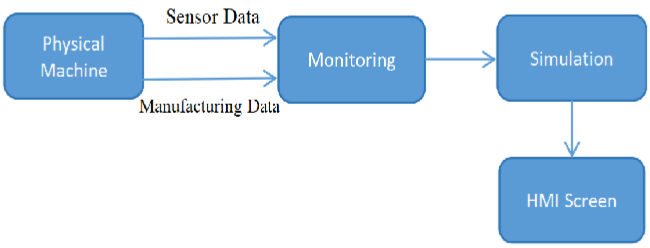

***Figure 6**: Block Diagram of digital twin.*

These data are continuously communicated to and aggregated by the digital twin application . The digital twin application continuously analyzes incoming data streams. Over a period of time, the analyses may uncover unacceptable trends in the actual performance of the manufacturing process in a particular dimension when compared with an ideal range of tolerable performance. Such comparative insight could trigger investigation and a potential change to some aspect of the manufacturing process in the physical world.

The model specifically finds expression through five enabling components—sensors and actuators from the physicalworld, integration, data, and analytics—as well as the continuously updated digital twin application.

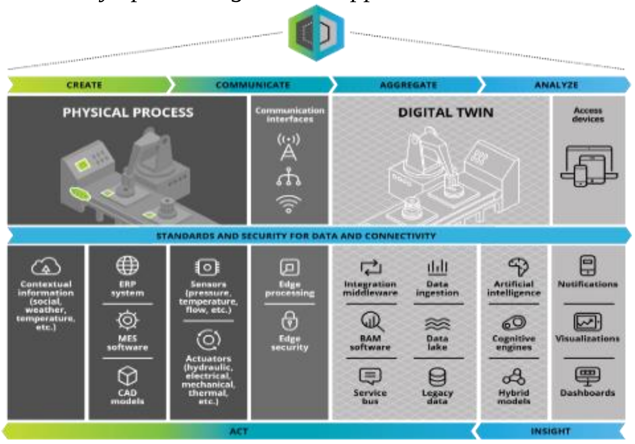

***Figure 7**: Digital twin conceptual architecture.*

• *Sensors¬¬¬¬¬— Sensors distributed throughout the manufacturing process create signals that enable the twin to capture operational and environmental data pertaining to the physical process inthe real world.*

• *Data— Real-world operational and environmental data from the sensors are aggregated andcombined with data from the enterprise, such as the bill of materials (BOM),10 enterprise systems,and design specifications. Data may also contain other items such as engineering drawings, connections to external data feeds, and customer complaint logs*

• *Integration— Sensors communicate the data to the digital world through integration technology (which includes edge, communication interfaces, and security) between the physical world and thedigital world, and vice versa.*

• *Analytics— Analytics techniques are used to analyze the data through algorithmic simulations andvisualization routines that are used by the digital twin to produce insights.*

• *Digital twin—The "digital" side of figure 1 is the digital twin itself—an application that com bines thecomponents above into a near-realtime digital model of the physical world and process. The objective of a digital twin is to identify intolerable deviations from optimal conditions along any of the various dimensions. Such a deviation is a case for business optimization; either the twin has anerror in the logic (hopefully not), or an opportunity for saving costs, improving quality, or achievinggreater efficiencies has been identified. The resulting opportunity may result in an action back in the physical world.*

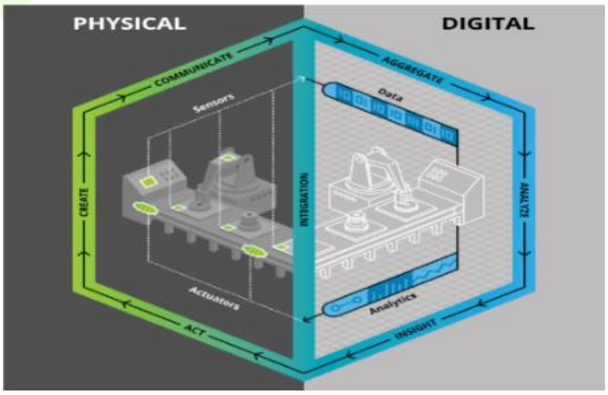

***Figure 8**: conceptual architecture.*

• *Actuators— Should an action be warranted in the real world, the digital twin produces the action by way of actuators, subject to human intervention, which trigger the physical process.11 Clearly, the world of a physical process (or object) and its digital twin analogue are vastly more complex than a single model or framework can depict. And, of course, the model of figure 1 is just one digital twin configuration that focuses on the manufacturing portion of the product life cycle.12 But what our model aims to show is the integrated, holistic, and iterative quality of the physical and digital world pairing. It is through that prism that one may begin the actual process that serves to create a digital twin.*

IV. METHODOLOGY

1. Machine overview
This Lab-works emulates a cap processing line, which is divided into two stations.

Station 1 – Pickup station:
Multi-coloured boxes are picked up from a (virtual) magazine and placed onto a conveyor belt, which moves the boxon to the second station.

Station 2 – Sorting station: The second conveyor belt moves the box on to the colour detection. The colour of the box is detected and the box are sorted according to their colour into the required lanes .

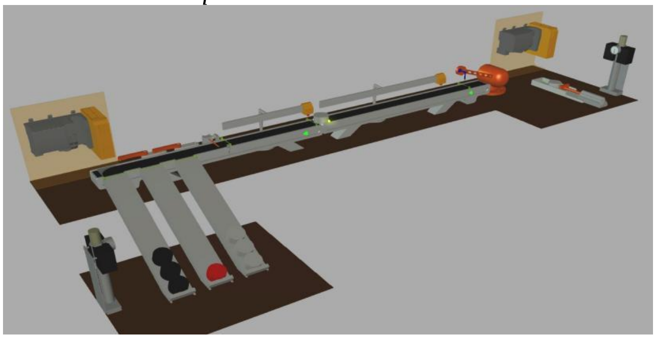

Figure 9*: Sorting and Distribution machine using digital twin technology.*

Machine shown in figure 9 is simulated by a digital twin, implemented with Industrial Physics (iPhysics).

1.1 Pickup station1.1.1Box pusher
The box pusher pushes the caps from the magazine position to the pickup position. When the box pusher moves back, a new is box automatically placed in the magazine position. There are two light sensors that detect box at the magazine position and at the pickup position.

The box pusher is driven by a pneumatic cylinder equipped with a spring return, so it automatically retracts when theoutput is turned off. There are two limit switches to detect when the box pusher is forwards and when it is back.

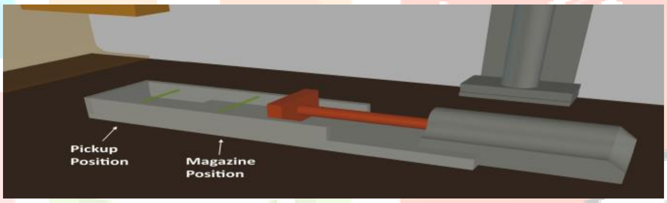

Figure 10*: Box Pusher for sorting and distribution machine.*

1.1.2 Pickup arm

The pickup arm loads the cap onto the conveyor. The pickup arm is controlled by a pneumatic rotary drive: One outputmoves the pickup arm to the pickup position and another output moves the pickup arm to the drop off position. These two outputs for the pickup arm movement must not be switched on at the same time.

The pickup arm uses a vacuum gripper to hold the caps. The vacuum of the cap gripper can be turned on and off. A vacuum sensor gives feedback whether a cap is successfully being gripped.

There are two limit switches installed for position feedback at the pickup and drop off position.

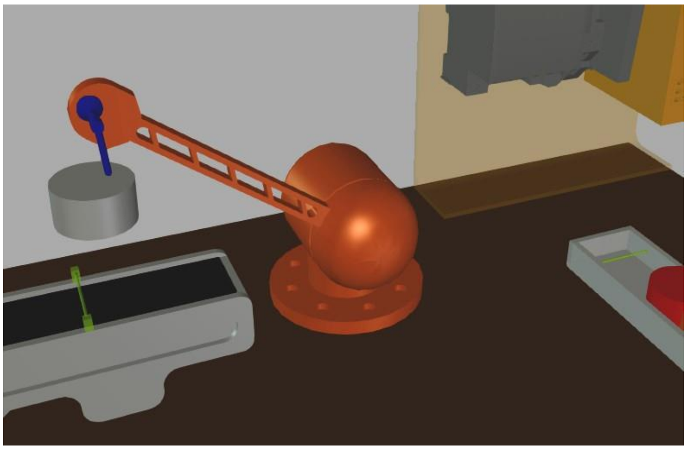

Figure 11*: Pickup arm for sorting and distribution machine.*

1.1.3 Logo conveyor

The logo conveyor transports the box to the sorting station. The conveyor belt can be moved forwards and backwards.There are two light sensors placed on the conveyor, one at the begin and another one at the exit of the conveyor belt.

To control the conveyor belt, use a MpAxisBasic function block to send the set speed to the simulation model. Greenarrow indicators on the conveyor show the current movement direction.The logo conveyor has a total run length of 70 cm, the distance between the two light sensors is 58 cm.

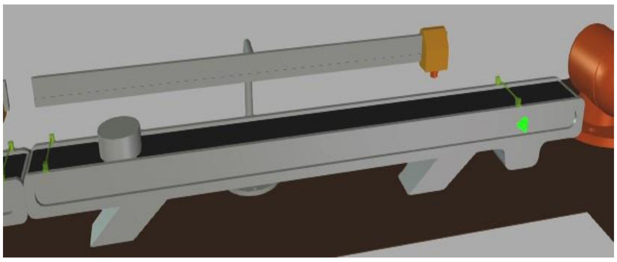

***Figure 12**: Logo conveyor for sorting and distribution machine.*

1.2 Sorting station

1.2.1 Sorting conveyor

The sorting conveyor transports the caps through the sorting station. The conveyor belt can be moved forwards and backwards. There are two light sensors placed on the conveyor, one at the begin of the conveyor belt and another one at the colour detection.

To control the conveyor belt, use a MpAxisBasic function block to send the set speed to the simulation model. Greenarrow indicators on the conveyor show the current movement direction.The sorting conveyor has a total run length of 70 cm, the distance between the two light sensors is 29 cm. The distance from the colour detection light sensor to the end of the conveyor is 37 cm. The maximum allowed speed is 500 mm/sec. A positioning accuracy of 0.1 mm is required.

***Figure 13**: Sorting conveyor for sorting and distribution machine.*

1.2.2 Colour detection

Before the caps can be sorted into the required lanes, their colour must be identified. A light sensor indicates that a box has entered the colour detection area. Box are stopped by the box stopper until colour detection is completed.

There are two sensors built into the colour detection: One sensor detects whether the box has a metallic surface (redbox). A second sensor detects whether a box is black. In combination, all three kinds of box (red, black, green = metallic) can be distinguished.

REQUIREMENTS

Each requirement for this project will be scored individually. The sum of these scores will equal your final grade for the project. Although there will be opportunities for extra credits, the core requirements must be met in order to qualify for extra credit points .

Common requirements

*Programming languages and required technology The motion tasks have to be implemented in **Ladder Diagrams**. The rest of the project (main control, pneumatic controls, communication part, recipe handling,...) has to be implemented in Structured Text. Extra credit implementation can be done either in Ladder Diagram or in Structured Text.Visualization must be implemented with mapp View.Motion programming must be done in the latest version of mapp Motion.*

Software versions

At the beginning of the LabWorks the trainer will specify the exact version numbers of AS, mapp View, mapp Servicesand mapp Motion to be used .

Software architecture

The application should be designed according to modular programming principles. Design the application so that functionality is separated into independent, interchangeable modules, such that each contains everything necessary to execute only one aspect of the overall machine functionality. Focus on high readability and little complexity of your source code. Higher levels of complexity in software increase the risk of introducing defects when making changes. In more extreme cases, it can make modifying the software *virtually impossible. Assign all tasks (modules) to the appropriate task classes. Keep CPU usage in mind and optimize the cycle times of the task classes. Any external documentation you provide to the customer must be included in the Logical View of the AS project.*

Hardware topology:
The project should be realized in an ARsim environment with simulated drives. Create therefore a "Standard PC" configuration and insert the necessary number of drives with some motors.

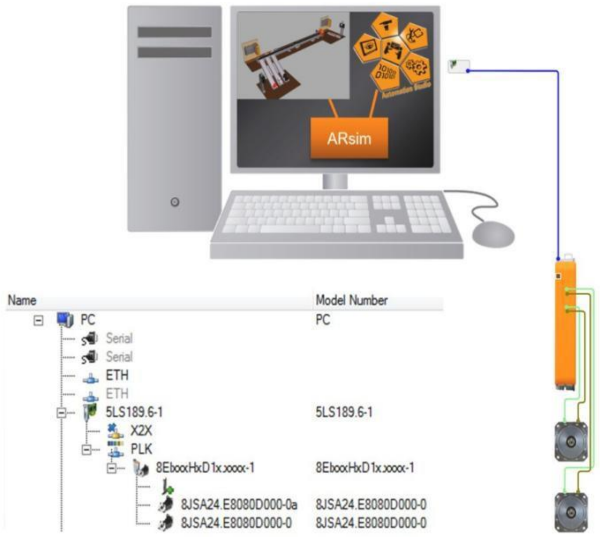

***Figure 14**: Hardware topology.*

V.ADVANATGES AND DISADVANATEGS OF DIGITAL TWIN

A wide variety of data regarding possible Keep CPU usage in mind and optimize the cycle times of the task classes. Any external documentation you provide to the customer must be included in the Logical View of the AS project outcomes can be obtained even before the product is manufactured with the use of digital twins. This data helps generate insights to optimize potential disruptions in production and operation, and can enable products to be designed more effectively, reducing potential capital expenditures. Even during the production phase of the product, systems can be monitored in real time with this technology, thus achieving and maintaining the highest efficiency throughout the production process. Again, thanks to this technology, it is possible to decide how to evaluate the products that complete their life cycle. Risky processes at every stage can be simplified, time can be saved, physical effort can be reduced and the most suitable equipment can be selected and the life of the equipment can be extended. The many advantages of commissioning digital twins can be summarized as follows :

- *Real-time monitoring, control and data acquisition: Realtime updates via the digital twin are exchanged between physical and digital systems, allowing all to be monitored. Updates allow obtaining all the necessary data for business decisions and providing control over the physical system when necessary.*

- *Business continuity through remote access: As the digital twin is accessible to remote users around the world, it guarantees the participation and cooperation of all relevant parties in times of downtime,even though they are not physically present in the physical system. Increased efficiency: Digital twinsfacilitate the testing process of various scenarios and situations before they are implemented in physical systems, providing a platform to pretest solutions and apply the best ones to increase overall system efficiency.*

- *Highly informed decision support: All real-time data is collected on a single platform. At the same time, data analytics tools are easily accessible to feed. This enables faster, more informed and more efficient business decisions to be made.*

- *Predictive maintenance and optimized scheduling: Integrating artificial intelligence and machine learning techniques into the digital twin, predictions can be made to evaluate optimal maintenance times to avoid downtime.*

- *AI techniques can also optimize business process planning for improved productivity.*

- *Advanced risk assessment: The digital twin allows various solutions to be virtually tested and analyzed regardless. In other words, it offers the chance to evaluate these solutions without affectingthe physical system.*

Developing digital twins is a significant investment, and the realities of investment can be at a disadvantage. Namely, it may be possible for big companies to have the necessary capital and human resources and create an oligarchy. Ofcourse, this is not always the case. Small companies can contribute certain modules-such as statistical and graphicalenvironment that others can purchase. Another situation is that digital twin technology creates unequally distributedequipment and knowledge. In such a case, the gap between rich and poor, urban and rural can widen. Another disadvantage of digital twin technology can be listed as follows:

- *Distrust of companies and technological infrastructures in the protection of privacy and personal data:The Internet, which becomes more personalized with each passing day, is open to a large number of intruders. The importance of this issue has increased in recent years, both for companies, governments and consumers. In this period, in which the transparency and reliability of the public and private sectors in accessing, using and benefiting from personal data are increasingly concerned, in addition to the concern about data leaks that may occur as a result of security weaknesses, hacking, internal support or inaccuracy, especially digital which is a matter of debate what effect the privacy issue will have on the adoption of twin technologies.*

- *Lack of Human-Centered Approach: In today's traditional Cloud-centered IoT ecosystem, informationcollected from connected devices is stored, the way and purpose of storage, authorities with access to and control of information, economic benefits and direct economic benefits from the outputs obtained from the analysis of information when the expertise is evaluated, it is observed that the architectures used and the systems designed are more business, information and technology oriented. Noting that the lack of a human-centered approach is one of the most important barriers tounlocking the potential of the digital twin, Gartner identified one of the main strategic trends of 2019 and 2020 as "Human-Centered Smart Spaces". Making the digital twin concept a natural part of people's interactions with the digital world and their daily lives, establishing infrastructures that will efficiently distribute applications, services, services (such as Machine Learning, Artificial Intelligence)* over the digital twin, adopting an approach that emphasizes the human dimension of technologymakes the acceptability of the digital twin easier.

- *Restricting the value and realm of freedom to information: In today's technology age, where information is now a tangible asset, the size of the amount of dark data produced in the context of the digital twin ecosystem reveals how the financial and value creation potential of the digital twin islimited. Due to reasons such as resource and time constraints, costly, heterogeneous and unstructured data, ambiguity of the guide data or data source, low quality and efficiency in the data collection process, the data is either out of the knowledge of the enterprises or stuck in the closed private systems of the enterprises and only the company's own and is shrouded in darkness at the initiative of the reach of its few stakeholders.*

VI. LITERATURE SURVEY

This paper [1] shows a new approach for continuous recognition and sorting of objects into desired location. Image or colours processing nowadays attract massive attention as it leads to possibility of widening scope of applicationin different field with the help of modern technology. A colour sorting robot is researched, designed and created with Arduino Uno microcontroller, TCS3200D Colour Sensor, SG90 Tower Pro Servo Motor and other electronic components. The system has the ability to sort the object according to their colours into respective colour station in minimum time. In order to create a smart robot that can recognised colour ball and placed them at the correct location, research in length is needed. There are existing robot using PIC and other microcontroller but there are not many created using Arduino Programme. The real contribution of this system is that it is able to save time to sort the colour hence making this Arduino-powered colour recognising and sorting robot more efficient than the existingsorting system.

This paper [2] In the Automatic Sorting System, precision volume and size of the parcel boxes are all concerned. Different box size will certainly have a limited of personnel who visually identify and pick the objects. Computer vision are related to image processing and image analysis tend to focus on 2D image by pixel operation. Contour- based object detection is one alternative can measure the area for objects. In this paper will be in designautomation development of a computer vision system that is able to get the volume of the parcel boxes. To get this this value if know the amount of length, width, and height. To find out the dimensional scale of parcel will be used two webcam cameras by calculating the pixels that are captured on camera and making comparison for calibration. The 2D image consists of two images from camera captured with vertical and horizontal view. After getting the length, width, and height of the parcel box, there will be a multiplication program is used to obtain the result of volume. It be separated automatically on the conveyor belt. The system can identify boxes to within 1 - 15 cm in length and width and within 5 - 20 cm in height. For the evaluation, some of boxes were sorted into three categories. The experiment result showed that the Automatic Sorting System is able to sort them out with an accuracy of 87.5%.

The research [3] word presents a conveyor controlled unit application using a programmable logic controller.Duringthe operation such a system is continuously changing its state due to various events that can be appeared. For a design engneer it is very important to identify all the possible states of the system in order to correctly program the behavior of the system in order to minimize the time needed to restore the operation. We have proposed a system which would increase the production rate and accuracy of material handling systems. The system whould segregate objects based on their type i.e metal or non-metal, color as required by the user. PLC with the frame of logic gates will make program modification easy and thus, we can modify the system according to the requirement.The system consists of proximity sensor, color sensor, Omron sysmac PLC CP1E and conveyor belt.

The metal defect is detected with the help of the proximity sensor. [4]With the development of the technologies such as computer vision, natural language interaction, process control technology, and sensor technology, the discussion of automatic sorting system of robot hits a hotspot in waste recycling domain[1] and parcel or product sorting domain these years. Industrial robots could previously only complete automatic sorting using fixed programmes, which strengthens specificity while reduces expansibility of robots. As more and more diverse requirements for automatic sorting are put forward in industrial production, it becomes more and more difficult for previous industrial robots to meet requirements, so teaching-playback robots and robot programming languages have been developed.[4] Robot programming languages can be divided into action-level, object-level, and task-level programming languages according to the levels of operation description. Among them, a task-level programming language refers to a language showing a higher level than the former two languages and is the ideal programming language.
An automatic operating system for a robot, based on interaction with Chinese natural language and integrating advanced technologies, such as 3D visual perception, human–robot–environment interaction, and automatic programming, was designed for use in the automatic operating system of a modular industrial manipulator. In the experiments, the recognition time for 3D scenes, object recognition accuracy, and fruit-sorting accuracy are tested.

VII. CONCLUSION

This article highlights the increasing significance of digital twin technology in every sector of World. By utilizing advanced technologies, we can access tools and services to enhance crop yields, minimize wastage, and improve profitability,contributing to the overall development. This technology holds a huge amount of promise for the upcoming years to come with further growth of artificial intelligence technology and virtualization of agriculture. Some of the future scopes of digital twin technology in daily life could include:

- *Healthcare: Digital twins could be used to create personalized medical treatments for patients by modellingtheir anatomy, physiology, and genetic makeup. This could lead to more effective and efficient treatments and better patient outcomes.*

- *Transportation: Digital twins could be used to simulate traffic patterns and optimize traffic flow, leading toreducedcongestion and improved transportation efficiency. They could also be used to model the behavior of autonomous vehiclesand optimize their performance.*

- *Manufacturing: Digital twins could be used to optimize the design and production processes of manufacturing plants,leading to reduced waste and improved productivity.*

- *Energy: Digital twins could be used to model energy systems and optimize energy usage, leading to reduced energyconsumption and lower carbon emissions.*

The use of digital twin technology in robotics can greatly improve the efficiency and safety of human-robot interaction, especially in scenarios where there is a high risk to human life. By creating virtual replicas of physical robots, designers can identify and eliminate errors in a virtual environment, saving time and money. In addition, theuse of data-driven models and machine learning algorithms can optimize robot performance and predict maintenance needs. In this paper, we have provided an overview of the key components of a digital twin for automation including the physical element, the virtual element, and the middleware, the service and transport components. We have also outlined a five-step process for designing a robot using Digital Twin technology, which includes CAD design, simulation, data management, data analysis, and human-machine interaction. By using DigitalTwin technology, designers can not only create better performing robots, but also improve the overall sustainability of the work environment. Using of Digital Twin technology in robotics will continue to play an important role in various areas of human activity, including post-war reconstruction and disaster relief. The further development of the research is the implementation of digital twin technology for a rescue robot according to the proposed stages: building a computer model, programming robot behaviour in a simulation system, developing a mathematical and digital model of the robot, implementing humanmachine interaction between a physical robot and its digital replica,which will allow testing the interaction of the main components of the digital twin, performing data exchange between the physical and digital replica, and building a digital data model to verify the main operation.

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