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Modeling and Simulation of a Goods Sorting Plant Based on Programmable Logic Controllers (PLCs)

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Abstract:
the rate of production has drastically expanded in today's technologically advanced world due to fast-moving industries. Typically, manufacturing companies continue to produce the same models with few variations in length, color, weight, and shape. In addition, the sorting is crucial in this situation. In such circumstances, the industries cannot afford for their products to be sorted by human error. Low-cost automation (LCA) has to be created as a result in order to sort these products accurately. Industrial automation is largely concerned with creating automation that is affordable, requires little upkeep, has a long lifespan, and is as user-friendly as feasible, At last, we have established an LCA system for trying to sort lightweight objects predicated on size difference utilizing DC geared engines that are controlled by a microcontroller (PLC), and the provider goes in the system located in front of the detectors and thus the sorting logic is characterized, and the latest studies depend heavily on the layout of And the advancement of a system that works instantly without human involvement in order to transport out this sensitive task that requires precision. Accordingly, as the study concludes, we require an automated system that utilizes automation, the PLC system, and programmed logical controllers next.

Keywords: PLC, LCA, microcontroller, goods, Siemens, conveyor

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INTRODUCTION

Research into the production process and invention of new goods are the cornerstones of the growth of the manufacturing sectors. High industrialization rates are indicative of industrialized nations, whilst low industrialization rates are indicative of underdeveloped nations. Raw materials are changed into a

product during treatment. This product gains value through sales after processing. Manufacturing thereby "adds value" to materials. The product's worth must be greater than the cost necessary for the organization to profit from it. Sorting is crucial in this situation since manufacturing firms frequently produce models that are similar in length, color, weight, and shape. once upon a time [1]. To handle comparable issues, physical labor was one option. However, at the moment due to increased production and decreased labor Industries cannot tolerate errors for such low-skilled activities like sorting these products. This compelled the sector to disperse the sorting procedure. In order to accurately sort these products, low-cost automated (LCA) development was required. Automation is primarily concerned with creating robotics that is low-cost, reduced, long-lasting, and as user-friendly as possible [2].

In our study, we created a low-cost automated system for classifying lightweight objects according to variation in height. Using electro-optical and laser sensors, Gear box motors, and a microcontroller connected to a computer [3], the project primarily focuses on sorting various objects of various heights and sizes (PLC). The object is transported using this DC motor from the conveyor to the sorting bin. The PLC controls the sorting logic of the system, which consists of a conveyor belt that transports items like bottles, small boxes, or packages in front of the sensors. Three distinct logics, each of which sorts a different height product, are programmed into the PLC. Photoconductive or optical near sensors are utilized in the system to detect the presence of both the object's size and the boxes' height The pre-feed conveyor and the main conveyor are the two conveyors that are currently part of our project. The pre-sole conveyor's purpose is to haphazardly feed different height bins to the main conveyor. The primary conveyor belt's job is to transport the boxes in front of the height measurement station. We have zeroed in on the design of the primary carrier. A three-phase AC induction motor driving the main bus is managed by a PLC-connected variable frequency drive [3, 4].

THE INTEREST OF THE STUDY

This study is useful in clarifying the mechanism of programmable logic controllers and managing them in the way that the programmer desires in order to carry out the required tasks in real time so that there is no need for human intervention and it is considered one of the advanced systems these days that can be relied upon and trusted. It works quickly based on the data it receives [5].

GENERAL CONDITION AND COMPONENTS

The work environment will be a factory that produces 4 varieties of products and each has different features and characteristics from the other product. We were relied on these differences for the sorting process of the products so that we have a production line that is under the control of software controllers (not the focus of the study) and the production line is followed by a sorting line The products are also set to be controlled and controlled by programmable logic controllers (PLC) [2, 4].

THE INGREDIENTS

We were had two types of components and mechanisms used (hardware and software). The physical components, which are: (PLC programmable controllers, the sorting process line, and a group of motors and sensors installed on the conveyor) [6].

The software components are the programs used and the programming languages of Al Mutakmom PLC in order to control the entire process and make it fully automated, so there is no human factor here.

To explain the components through the illustration in the Fig. 1, which shows the components and how to connect the components in an engineering way (Fig. 2), in addition to the controller responsible for controlling the process [7].

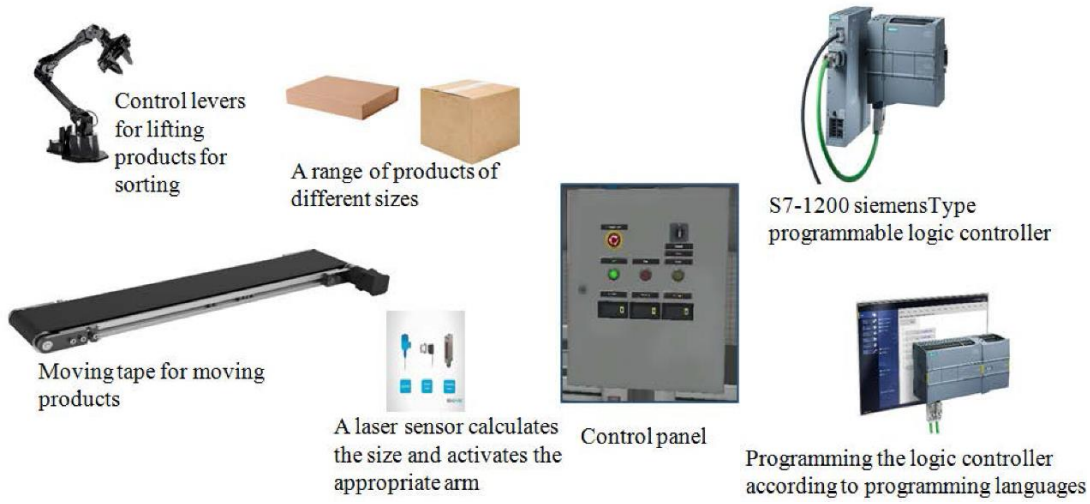

Figure 1: The set of software and hardware components involved in the research.

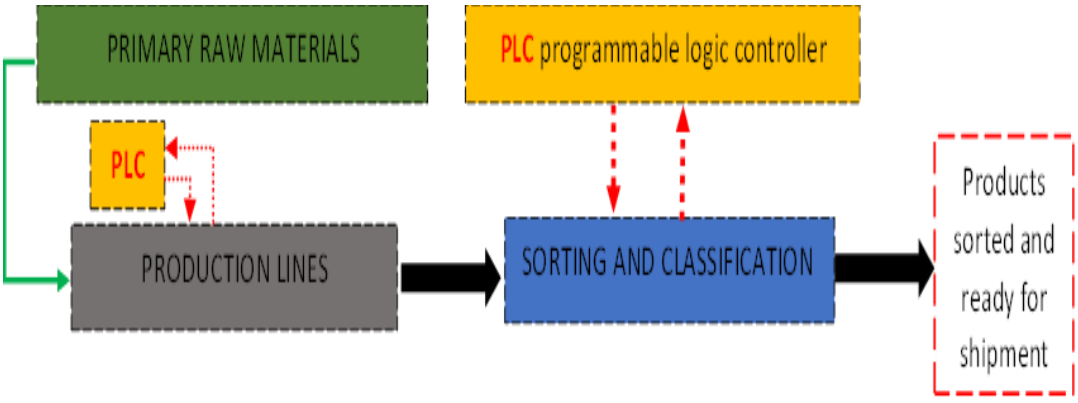

Figure 2: Factory master plan.

How the System Works

In the beginning, we have a conveyor belt at its beginning. Products that are in the form of wrapped and closed cartons are entered or removed, and each of us has a specific measurement (we can depend on the measurement in the classification process) [8]. The special device installed on the side of the belt so that the sensor measures the dimensions of each parcel that passes in front of it and activates a specific mechanism in order to take the parcel (the mechanism may be pushers and direction changers or mechanical arms that lift the parcel according to the classification that the parcel takes) and this process as a whole is driven by a controller Programmable logic In this case we can use a programmable logic controller of type (S7-1200 siemens, Fig. 3) [9], It is suitable for study because it is one of the modern and very popular programmable logic controllers, especially in simulation and modeling interfaces such as Tia Portal and factory simulators [10]. It contains a number of inputs and outputs So that the inputs of the controller can be linked with the outputs of the sensors on the side of the belt [11], and the output of the controller is connected with the pushers and direction changers or the robotic arms that sort according to the data of the logical controller and the sensors [11, 12].

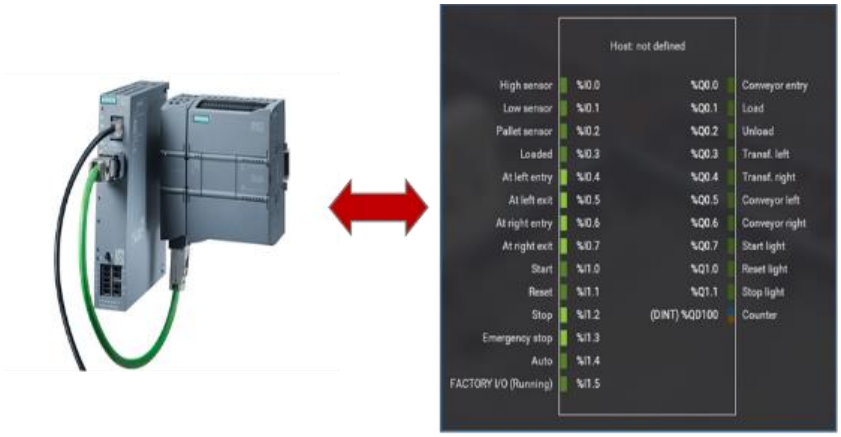

Figure 3: S7-1200 PLC.

THE MECHANISM OF THE SORTING PROCESS

We resolve explain the working mechanism of the sorting belt or the sorting line in the factory so that when a parcel arrives at the beginning of the sorting belt (conveyor conv), the motor connected to the continuous current works in order to continue the movement of the parcels (Fig. 4). In the middle of the belt there is a size sensor (measures the size of each parcel) and based on Package measurements and the database provided by the sensor [13, 14]. One of the robotic arms is activated in order to retrieve and lift the package at a specific position of the moving belt, so that we have three types (Fig. 5), three automatic arms, a size sensor and motors for the belt (the robotic arms can be replaced with pushers and direction changers) [15, 16].

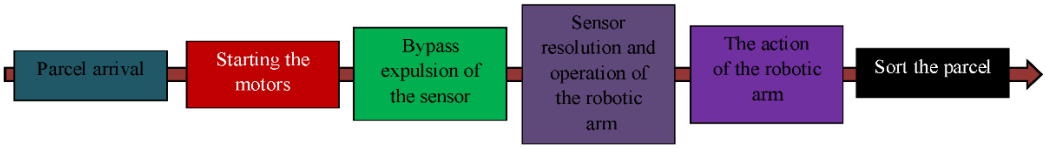

Figure 4: Workflow when the package arrives.

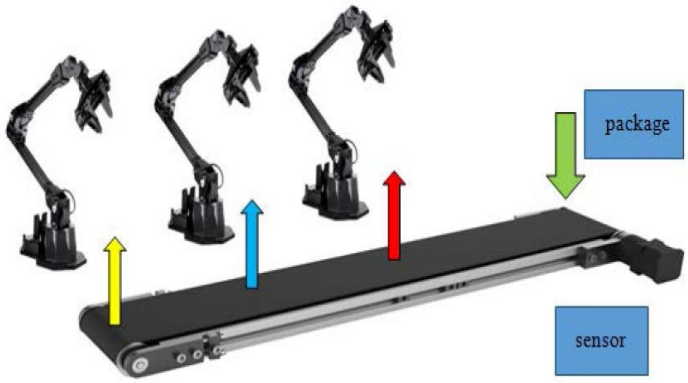

Figure 5: Illustration of the sorting tape, robotic arms, and sensor.

PROGRAMMING THE MICROCONTROLLER AND PROCESS CONTROL SCHEME

We can model the process using the famous emulator for control operations (TIA Portal 13/14) in order to write the programming language and program the programmable refractory controller (Siemens-s7-1200) using the Lader language for controlling the operations [17]. Fig. 6 shows the control diagram with a simple explanation for each branch of the program network [12, 14].

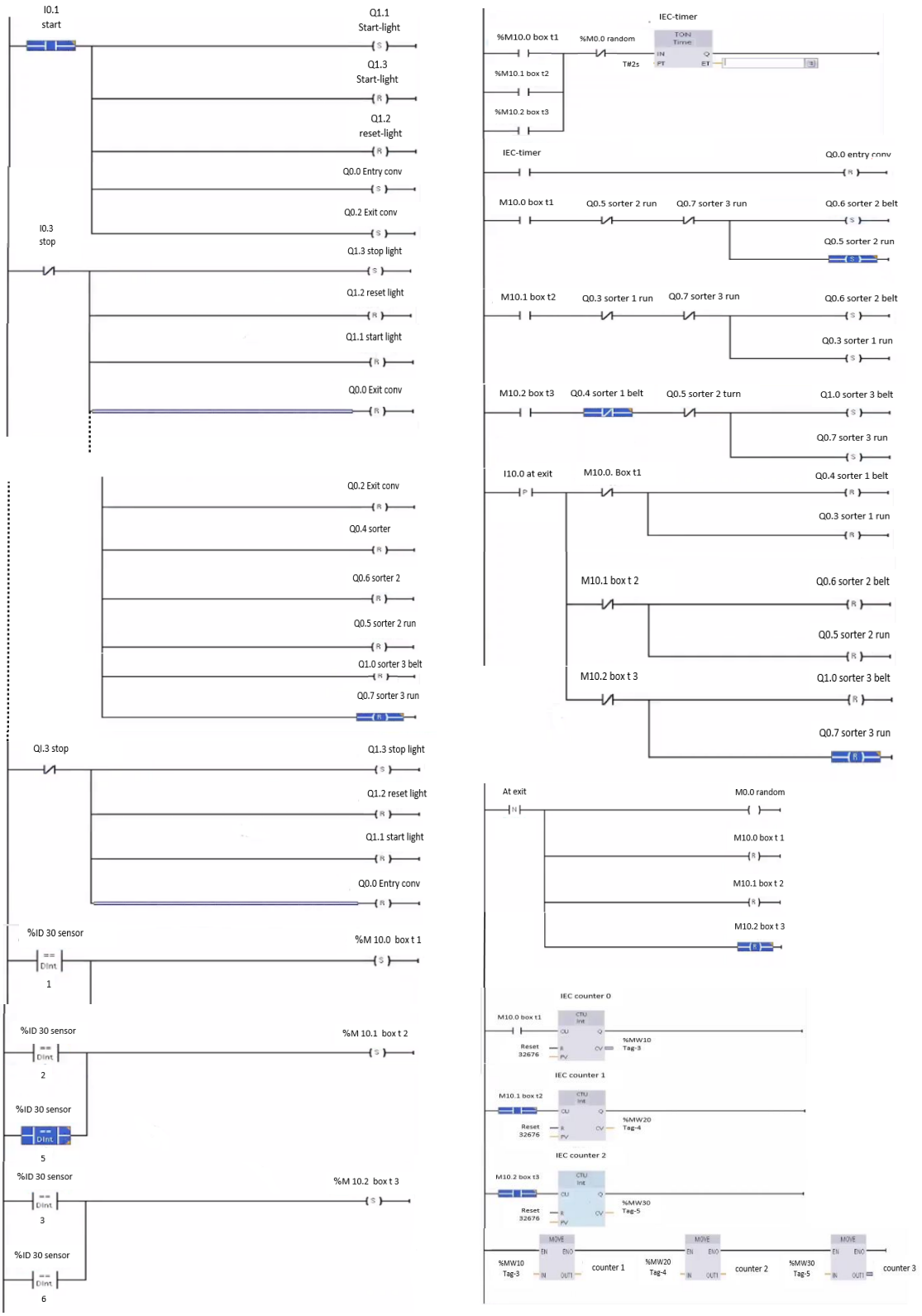

Figure 6: Control diagram with a simple explanation for each branch of the program network.

CONCLUSION

This project's primary goal was to create an object sorting system based on a set of requirements. In this case, it has been put into practice successfully. We see this effort as a journey where we learned new things and developed new perspectives on the subject of this report. PLC was employed to manage a number of processes. More benefits the following can be included in this system: Things' shape and weight can be expressed in terms of volume. Ad hoc sorting is possible with a file piston arrangement. Along with PLC support, it is quite helpful in a range of industries, particularly in the packing process. The automated handling device increases operator safety, pragmatism, and efficiency. It promises exceptional handling capacity, unmatched performance, and color a statement. Of course, high speed DC motors are necessary. sensors for industrial applications that have a phenomenal reaction time.

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