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REVIEW PAPER ON ELECTRICAL SYSTEM FOR SIZE BASED BOX SORTING

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Automation, Sorting , Electric System

Abstract

An important step forward in industrial automation has been made with the installation of an electrical system for size-based box sorting. This system uses sophisticated sensors, controllers, and actuators to optimise the sorting process. This project aims to decrease manual labour and errors while increasing overall efficiency. It addresses the critical need for improved supply chain management and logistics in many sectors. Modern technologies are integrated into the system, such as conveyor systems, box detecting sensors, and a size measurement system that uses laser or infrared sensors to measure dimensions precisely. The key components of the proposed system are a size measurement system that ensures precise dimension assessment, a conveyor system that facilitates smooth box transportation, and box detection sensors that identify the existence of boxes. The central processing unit is a microcontroller or PLC, which uses sensor data to make well-informed sorting decisions. Using pneumatic cylinders, solenoids, or servo motors, the sorting mechanism effectively directs boxes into specific chutes or conveyor lanes according to their size. Operators may easily monitor and control the sorting process with the help of the Human Machine Interface (HMI), and smooth information flow between system components is made possible by a strong communication system. Safety is the primary priority, and to that end, emergency stop mechanisms, safety sensors, and an extensive feedback system are all integrated to both prevent accidents and confirm the accuracy of the sorting. Thorough testing confirms the effectiveness of the system in a range of scenarios, taking into account variables like sorting accuracy, box size compatibility, and conveyor speed. The system's modular architecture facilitates maintenance and scalability, allowing it to be easily adjusted to meet the changing requirements of sectors that depend on effective box sorting. To sum up, this initiative promises increased accuracy and efficiency in supply chain management procedures, which is a significant advancement in logistics automation.

INTRODUCTION

Research into manufacturing processes and innovation in new products are essential to the growth of manufacturing industries (Pothi et al., 2023)**.** Higher manufacturing rates are associated with industrialised nations, while lower manufacturing rates are associated with poor nations (Wairagade et al., 2023). The raw material is changed into a product during processing (Kokkawar et al., 2023). This product gains value for

sale after it is processed. Manufacturing, thus, "adds value" to the material. In order to enable the organisation to profit from the product, its value should be more expensive(Uikey et al., 2023). Sorting is crucial in this situation because manufacturing businesses typically continue to produce the same models with minimal variations in height, colour, weight, and shape (Ambudare et al., 2023). Sorting comparable objects by hand was a feasible method in the past. But these days, enterprises can't afford human error when it comes to sorting these products because of rising output and the need to minimise labour expenditure for such an unskilled operation (Baghele et al., 2023). The industry was compelled by this to go towards atomizing the sorting procedure (Bhambulkar, A.V. ,2011). Low Cost Automation (LCA) must be developed in order to accurately sort these products because economics has always played a significant role in the development of industry (Bhambulkar, A., V., Gaur, H., & Singh, A. K. ,2021). The secret to success in the automation sector is constant innovation and figuring out practical ways to boost output and reduce operating costs (Ganorkar R. A. et al. ,2014). Growing market awareness and a strategic reevaluation of the value chain are required due to the automation systems' growing demand. The primary goals of industrial automation are to create low-cost, long-lasting, low-maintenance systems with the greatest potential user friendliness (Bhambulkar et al., 2023). For this project, we have created a Low Cost Automation System that sorts light items according to variations in height (Patil, R. N., & Bhambulkar, A. V.,2020). The primary goal of the project is to sort three objects of varying heights utilising DC geared motors and photo-electric sensors interfaced with a PLC (programmable logic controller) (Bhambulkar, A. V., & Patil, R. N., 2020). The object is pushed from the conveyor to the sorted bin by means of this DC motor. Conveyor belts in the system move items like bottles, little boxes, or packages in front of sensors; the PLC determines the sorting logic based on this information. Three distinct logics are written into the PLC, each of which is used to sort products of varying heights. The system, which measures the height of boxes and detects the presence of objects, is made up of four proximity optical sensors, also known as photo-electric sensors. The pre-feed conveyor and the main conveyor are the two conveyors that we currently have in our project. The pre-conveyor's sole purpose is to haphazardly feed boxes of varying heights onto the main conveyor (Bhambulkar et al., 2021). The primary conveyor belt's job is to move the boxes in front of the station for measuring height. Our primary conveyor design is our only concern. The main conveyor is run by a three-phase AC induction motor that is managed by a PLC-interfaced variable frequency drive. Proximity sensors are held in place by three metal plates(Rahul Mishra et al.,2013). The start sensor, which is located on the first holding plate, is responsible for starting the conveyor for a certain amount of time only in the event that an object is present (Nayak, C.B. ,2022). By stopping the conveyor motor if the object is not present, this will conserve energy (Nayak, C.B. ,2021). The entire assembly of the adjacent mounted second holding plate, which has two sensors organised to measure an object's height, is referred to as a height measurement station (John, B., Khobragade, N., & Bhambulkar, A. V. ,2022). The system is different from a special purpose machine (SPM) since this plate has a slot where we may change the height of the sensors to suit our needs (Kajal et al., 2023). The sensor on the third plate tells the VFD to slow down the conveyor belt so that the diverter may precisely push the object (Bhambulkar & Titarmare, 2022).

BLOCK DIAGRAM

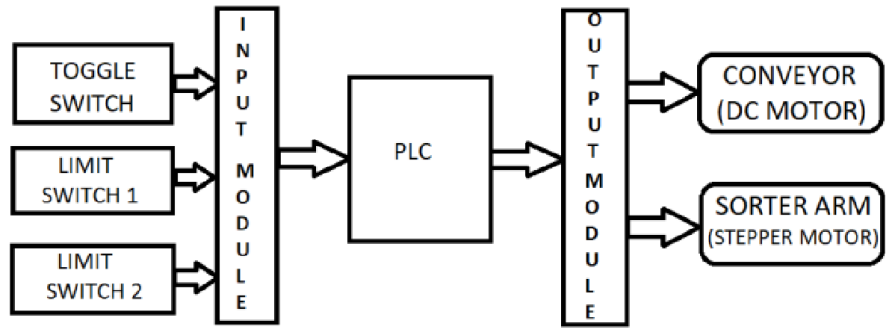

Fig.1 : Block Diagram

The System's Elements

- ***Photo-electric sensor:*** To detect the presence of objects and box heights, the system is made up of four proximity optical sensors, also known as photo-electric sensors. Our idea uses an IRD 183 diffuse type photoelectric sensor (Bhambulkar & Titarmare, 2021).
- ***Variable frequency drive:*** An electric motor can be driven by a VFD, a kind of motor controller, by altering the voltage and frequency that is provided to it (Jadhav & Bhirud, 2015).
- ***Three phase AC induction motor***: This type of motor is used to power conveyor belt assemblies. It operates on three phases. These motors are typically used in conjunction with VFDs, which have the ability to regulate speed in accordance with specifications.
- ***Conveyor belt:*** This system uses two conveyor belts: the main conveyor and the pre-feed conveyor. A typical mechanical device used to transfer things from one place to another is a conveyor system (Tijare et al., 2020).
- ***DC geared motor:*** This type of motor is crucial for pushing boxes. It is geared. This motor manages the diverter's clockwise and anticlockwise rotation. A metal strip that extends the motor's shaft is what will push the objects (Sahare, Mohadikar, Sharma, Bhambulkar, & Yerpude, 2019).
- ***Guider:*** The Guider is a mechanical assembly designed to stop boxes from being misaligned. Boxes will be forced to the centre of the conveyor by the guider. The diverter must be passed through by the box that the start sensor detected. When the boxes are not aligned properly, they may fall off the conveyor or encounter issues when being pushed. With the aid of a guide, the continuous flow of boxes may be set quickly.
- ***Programmable Logic Controller:*** Basically, a PLC is a hardware and software microcomputer with a user-friendly microprocessor foundation that is intended to regulate the functioning of industrial processes and equipment. One significant benefit of the PLC is its ease of programming and reprogramming. Leading PLC producers include GE Fanuc, Siemens, ABB, Allen Bradley, Honeywell, Mitsubishi, Modicon, Omron, and others.

The Controller Development System (CODESYS) is a development environment used to programme controller applications in accordance with the international industrial standard IEC 6111-3 (Gaurkhede et al., 2023). It is utilised to programme PLCs. Licences for CODESYS are free of cost and can be installed on additional workstations lawfully without copy protection. Despite having access to 250 distinct microcontroller and microprocessor options from 50 semiconductor suppliers, we continue to employ PLCs due to the benefits listed below.

- Compact physical form
- Minimal upkeep
- Possibility of online programming
- It is feasible to extend the I/O ports.
- Fast operation speed ❑
- Computer communication compatibility
- Device LPC
- Economical in managing intricate systems

CONCLUSION

This paper aims to decrease manual labour and errors while increasing overall efficiency. It addresses the critical need for improved supply chain management and logistics in many sectors. Modern technologies are integrated into the system, such as conveyor systems, box detecting sensors, and a size measurement system that uses laser or infrared sensors to measure dimensions precisely.

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