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Conveyor Belt Based Product Counting System

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Abstract: *This paper outlines the design and development of an innovative conveyor belt- based product counting machine capable of accurately detecting and sorting products in real- time, leveraging advanced sensors techniques to ensure precise counting and categorization as products move along the conveyor belt. By streamlining product counting and sorting processes, this machine is poised to significantly enhance efficiency and productivity in a range of industries, including manufacturing, packaging, and logistics, with experimental results confirming the system's accuracy and reliability, thereby underscoring its potential as a valuable solution for industrial applications where precision and speed are paramount.*

Keywords: Conveyor Belt, DC Motors, PLC Microcontroller, Colour Sensor, LCD

I. INTRODUCTION

Conveyor belt systems have become indispensable in modern industrial automation, particularly in manufacturing, packaging, and sorting industries. The growing need for enhanced efficiency, accuracy, and cost-effectiveness has driven the development of sophisticated conveyor belt systems that incorporate automation and smart sensing technologies. This paper presents a novel Conveyor Belt-Based Product Counting and Material Sorting System, which accurately counts products and automatically detects and separates metal and non-metal items. By providing real-time product counting and material sorting, this system significantly enhances productivity, quality control, and operational efficiency. Unlike traditional conveyor belt systems, which rely on manual supervision and are prone to errors, our proposed system leverages sensor technology and microcontrollers to achieve automated product differentiation and sorting. The system's versatility and accuracy make it an attractive solution for various industries, including manufacturing, recycling, food processing, and warehousing, where precise counting and sorting are crucial for maintaining workflow efficiency.

II. LITERATURE REVIEW

1) The paper entitled by MoghaddamVahedet.al.[1][2014], This paper introduces an intelligent approach for real-time inspection and object selection in continuous flow systems. Leveraging image processing, a technology with vast applications in high-tech fields, the authors focus on enhancing existing sorting systems within modular processing frameworks. The challenge lies in seamlessly integrating image processing capabilities into the four core stations of identification, processing, selection, and sorting."

2) The paper entitled by Vishnu R. Kale et.al.[2][2014], This paper presents a smart approach for a real time inspection and selection of objects in continuous flow. Image processing in today's world grabs massive attentions as it leads to possibilities of broaden application in many fields of high technology. The real challenge is how to improve existing sorting system in the modular processing system which consists of four integrated stations of identification, processing, selection and sorting with a new image processing feature.

III. METHODOLOGY

The proposed system utilizes the Allen-Bradley 1000 PLC as its core component, which can be programmed using ladder logic. A proximity sensor with a 300 mm range provides input to the PLC. The conveyor belt is driven by a DC motor, powered by a 12V DC battery. When an object is detected on the conveyor belt, the sensor emits a beam of electromagnetic radiation that is reflected back to the receiver, signal in the object's presence. A relay connected to the

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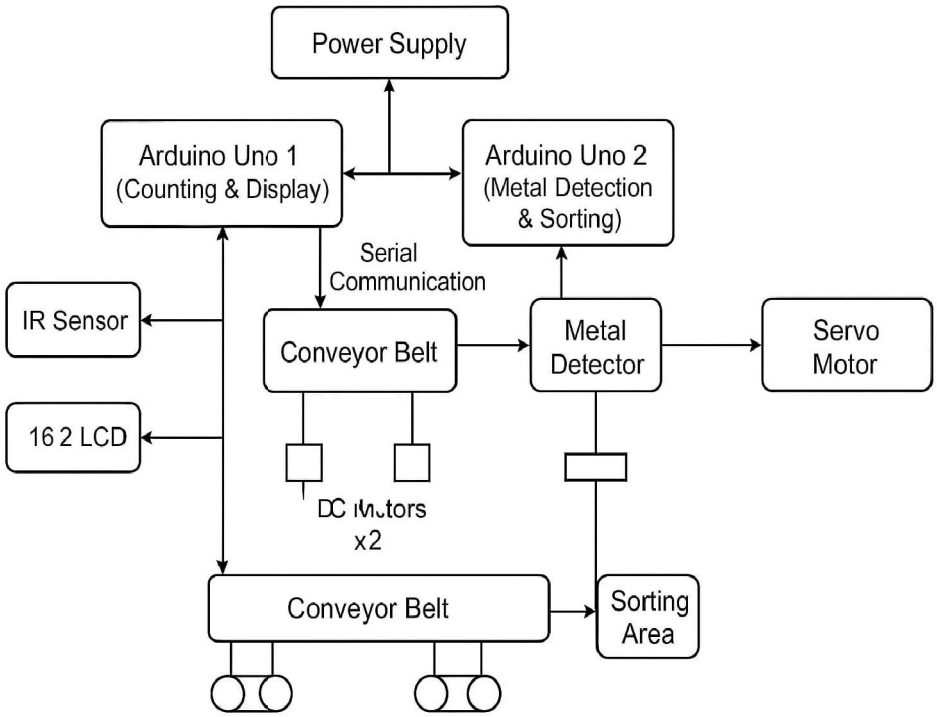
PLC enables control of high-current circuits using low-current signals. To prevent potential damage to the PLC from back EMF generated by the motor, a separate power supply arrangement is considered. The 12V DC battery powers the motor, while the PLC operates with a controlled power supply.

Block Diagram



WORKING

This conveyor belt system detects and separates metal and non-metal products continuously moving through it. The system operates with a power supply and a motor that drives the belt's continuous motion. When the metal sensor detects metal and the IR sensor detects non-metal, the Arduino controller sends a signal to the servo motor, which rotates 260 degrees to divert the non-metal products in one direction. Meanwhile, metal products continue on the conveyor belt, effectively separating the two types. The system also displays the total count of products passing through the conveyor belt. This automated sorting solution efficiently moves products from one place to another, streamlining the process.

IV. COMPONENT DETAIL

Conveyor Belt Speed Sensor

Conveyor belt sensors can monitor and control various parts of the conveyor belt, including its speed, temperature and position Conveyor belt speed sensors are designed to accurately monitor the speed of a conveyor belt. These sensors work by detecting the rotational speed of the rollers or by using optical or magnetic encoders to measure the speed of the conveyor belt directly. The primary applications of speed sensors include

Ultrasonic Sensor:-

An ultrasonic sensor is a device that measures distance to an object using high-frequency sound waves. It works by emitting ultrasonic pulses via a transducer, which then receive reflected echoes from nearby objects. These echoes produce distinct patterns, providing information about the object's proximity. By leveraging the reflection of sound waves across boundaries, ultrasonic sensors accurately detect and measure distances.

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Conveyor Belt:-

Conveyors are specialized conveyor systems designed to handle materials that need to be transported at steep angles or require controlled spacing between products. These conveyors feature cleats, or vertical barriers, attached to the belt at regular intervals. Cleats prevent materials from sliding backward, making cleated belt conveyors ideal for transporting loose or bulk materials on inclines or declines.

Metal Detector :-

Product Quality Control – Ensures that no unwanted metallic contaminants are present in food, pharmaceuticals, and other sensitive product. Sorting and Separation Differentiates between metal and non-metal objects, enabling automated separation of materials for recycling, manufacturing, and waste management.

Proximity Sensor :-

Proximity sensors detect objects on conveyor belts, enabling accurate and automated product counting through non-contact detection, which eliminates manual errors and ensures precise counting without damaging products. By utilizing inductive proximity sensors for metal detection and capacitive proximity sensors for both metal and non-metal detection, industries can achieve automated sorting and streamline their processes, resulting in increased efficiency, reduced costs, and improved accuracy in product counting and sorting.

Connecting Wire:-

The system's wiring infrastructure comprises various connections, including power supply wires that energize motors, sensors, and control units, while sensor wires link infrared, optical, inductive sensors, and metal detectors to the microcontroller for object detection and counting. Communication wires facilitate data exchange between the microcontroller, display unit, and external monitoring systems via protocols like RS232, I2C, and SPI. Motor control wires connect motor drivers, such as L298N, to the conveyor motor, enabling speed and direction control. Additionally, grounding wires ensure electrical safety and prevent short circuits, while display wires connect the LCD display, providing real-time monitoring and feedback.

Servo Motor (MG996R):-

The actuating servo motor plays a multifaceted role in product sorting and conveyor belt control, enabling efficient and accurate operation. It can divert metal and non-metal objects into separate bins by a flap or arm, while also regulating the conveyor belt's speed to match counting requirements, ensuring smooth operation and preventing miscounting. With precise angular movement, the servo motor facilitates accurate product counting, allowing for momentary stops or slowdowns as needed. Additionally, it can control a gate or stopper, regulating object flow and permitting a set number of products to pass through at a time, further enhancing the system's precision and efficiency.

16*2 LCD Display:-

1. Displaying Product Count Shows the total number of products passing through the conveyor belt. Continuously updates the count in real-time.

Displaying Metal and Non-Metal Detection Indicates whether the detected product is meta lor non-metal.

Example Display :"Metal Detected: YES" "Metal Detected: NO"

Displaying Conveyor Belt Status Shows whether the conveyor belt is running or stopped. Example Display:

"Conveyor: RUNNING"

Microcontroller:-

AT89C51 is a 8-bit microcontroller with the 4kb Flash which is more than enough for any small scale industry for memory storage. The number of IO's provided by this controller is enough for interfacing external peripherals and the interface can internally modified by using LED indication for the purpose of debugging. The operating frequency of the controller is around 11.059MHz is a crystal oscillator also known to be a 3pin resonator. It works for a supply of

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+5v on pure DC.

IR Sensors

TSOP1736 is said to have a photo detection response of 36KHz. This sensor is known to produce LOW output on detection else in an idle state. This sensor is also driven by BC557 transistor for biasing and then provided to the input of a micro-controller. The inputs of these microcontroller areexternal which can internally be modified to internally trigger the controller from the sensor.

Applications:-

1) Automates product counting.
2) Reduces human error.
3) Speeds up sorting process.
4) Enhances efficiency in packaging.
5) In industries producing water bottles

Advantages

1. Error-Free Counting: Automation eliminates human mistakes, ensuring precise product counts.
2. Streamlined Production: Efficient counting processes save time and reduce labor requirements.
3. Instant Inventory Insights: Real-time tracking enables accurate inventory management.
4. Labor Savings: Automated counting frees staff to focus on higher-value tasks.
5. Boosted Productivity: Optimized workflows increase production capacity.
6. Adaptable Integration: Easily integrates with existing production lines and accommodates diverse product types.

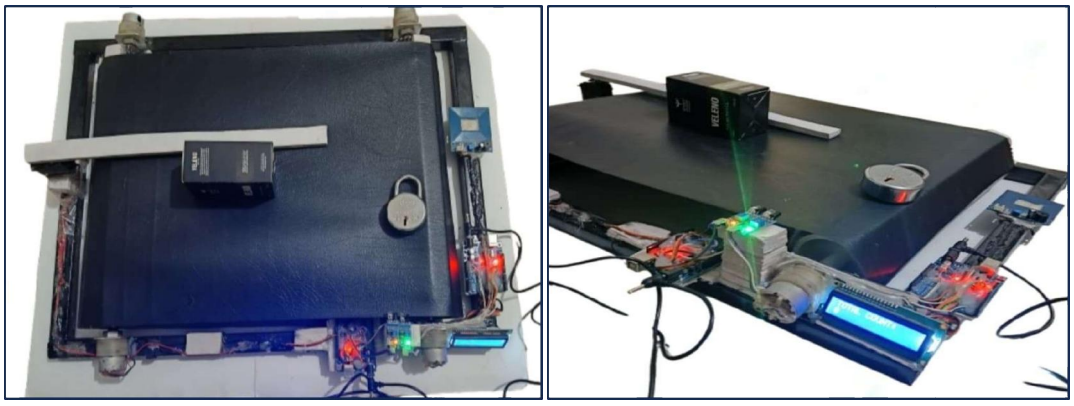
V. CONCLUSION

Our conveyor belt system efficiently sorts metal and non-metal items with precision, while providing real-time product counts. This reliable and robust solution boosts operational efficiency, making it ideal for industrial applications where accuracy and durability are crucial.

VI. FUTURE SCOPE

Conveyor belt-based product counting machines have a bright future, driven by advancements in automation, AI, and Industry 4.0. These innovations will boost accuracy, efficiency, and productivity, leveraging real-time data, predictive maintenance, and optimized planning. With robotics, machine learning, and IoT integration, these machines will become crucial in industries like manufacturing and logistics, enhancing overall performance.

VII. RESULT



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