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Object Sorting On Conveyor Using Image Processing

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Abstract
This project proposes an automated object sorting system using image processing technology. A camera captures images of objects on a conveyor belt, which are then processed and analyzed using computer vision algorithms. The system identifies the object's type, shape, color, and size, and sorts them into different categories. This automated system increases productivity, reduces manual labor, and minimizes errors. The proposed system is also flexible and can be easily integrated into existing industrial automation systems. Experimental results demonstrate the effectiveness of the proposed system in sorting objects with high accuracy. This project has significant potential for applications in manufacturing, logistics, and supply chain management.
Keywords: Object Sorting; Image Processing; Machine Learning; Computer Vision; Conveyor System

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I. INTRODUCTION

The application of image processing technology in industries has experienced tremendous growth, especially in automation and robotics industries [1][2].Companies now rely more and more on intelligent systems to enhance productivity in manufacturing, logistics, and quality assurance. One of the challenges of industrial automation is object sorting, which has traditionally been done manually or through simple sensor-based systems.This project is about designing a sort of automated object sorting system using image processing methods. The setup consists of a conveyor belt, a camera, three servo motors, a DC motor, and a controller, all controlled by a Python program that runs on a laptop. The camera is charged with taking photos of objects as they move down the conveyor, and the OpenCV library is used to recognize and classify objects based on attributes such as color and shape[3]. After classification, the corresponding servo motors are engaged to sort the objects into appropriate sorting bins.

Integrating automation in the process of sorting has a profound reduction in human work, minimizes the risk of errors, and increases overall efficiency [3][4]. Utilizing computer vision technology, the system can detect objects in real time, enabling seamless sorting operations. Object recognition is used in a wide range of applications across automation, surveillance, and medicine. The major purpose of this project is automatic detection and object classification by frame-wise processing images.

The hardware units used in this project include: A DC motor to move the conveyor belt, Three servo motors for sorting items based on their classifications,A camera for taking pictures of objects on the conveyor, A controller to regulate the motors and control the system's functionality, A laptop with Python and OpenCV used for image processing and making decisions.

The functioning of the system is quite simple: as the objects move across the conveyor belt, the camera takes their photos, which are then processed through Python and OpenCV [5]. The system sorts every object according to set parameters and switches on the right servo motor to push the object into the respective sorting container.

Past object sorting systems have generally relied on optical sensors, color sensors, and robotic arms. Some tracking robots utilize adaptive color thresholding for real-time classification. Also, numerous recognition methods, such as boosted learning algorithms, the Bag of Words model, template matching, and segmentation, are widely used in image processing-based object sorting.

This project is an extension of prior work with the added benefit of being cost-efficient and flexible enough for real-world industrial use[6][7]. By combining real-time image processing with an automatic sorting system, this system has the potential to significantly increase efficiency in industries where object classification and segregation are a necessity.

Object sorting systems have evolved over time, transitioning from basic mechanical segregation techniques to more advanced sensor-based and vision-based sorting methods. Earlier systems primarily used color sensors and optical sensors to differentiate objects based on hue and intensity levels [5]. However, these methods

had limitations when it came to recognizing objects with similar colors but different shapes or textures. To overcome these issues, modern sorting mechanisms now employ machine learning models, blob analysis, and segmentation techniques to improve classification accuracy [6].

Various computer vision-based object detection approaches have been explored, including template matching, boosted learning algorithms, and the Bag of Words model. The Bag of Words (BoW) approach has been widely used for both object and scene recognition in real-time applications [7] [8]. These advanced methodologies allow object sorting systems to function efficiently across different industrial sectors, including manufacturing, recycling, and warehouse automation. By integrating these techniques, the proposed project aims to provide a cost-effective and flexible solution for real-world industrial applications.

II. Methodology

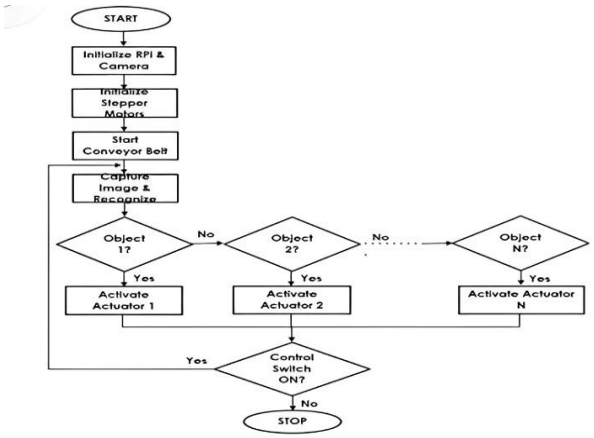

Fig 1. BLOCKDIAGRAM

The object sorting on a conveyor using image processing begins with initializing the system, including setting up the stepper motors and starting the conveyor belt. A camera captures images of objects moving on the belt, and an image processing algorithm analyzes the captured images to recognize and classify objects based on predefined characteristics such as shape, size, or color. Once an object is identified, the system activates the corresponding actuator to direct it to the appropriate location. This process continues in a loop, ensuring real-time sorting of objects with high accuracy and efficiency until the system is manually stopped.

2. 1 Components Used

2. 1 .1 DC Motor

FIG 2. DC MOTOR

The DC motor is responsible for driving the conveyor belt, ensuring continuous movement of objects through the system. It provides the necessary speed and torque to transport items efficiently. The motor speed can be adjusted based on the processing time required for object detection and classification. Proper motor selection is crucial for smooth and stable conveyor operation, preventing jerky movements that could affect image capture accuracy.

2. 1.2 Servo Motors

FIG 3. SERVO MOTORS

Three servo motors are used to control the sorting mechanism. Each servo motor is assigned to a specific category of objects and is responsible for directing them into the appropriate bins. Servo motors offer precise angular control, enabling smooth and accurate object movement.

2.1.3. Conveyor Belt

FIG 4. CONVEYOR BELT

The conveyor belt is the moving platform on which objects are placed for sorting. It is powered by the DC motor and designed to maintain a consistent speed to ensure steady object detection. The belt material should be non-reflective to avoid image distortion during processing.
The length and width of the conveyor can be adjusted based on the number and size of objects being sorted, ensuring smooth transportation throughout the system.

2.1.4. Laptop Camera

FIG 5. LAPTOP CAMERA

Instead of using an external camera, the system relies on the built-in laptop camera for capturing images. The camera is positioned to monitor the conveyor belt, capturing frames as objects move along. Since laptop cameras have a fixed position, proper placement of the conveyor and lighting adjustments are necessary to ensure clear image acquisition. The captured images are processed in real-time using OpenCV.

2.1.5.Controller (Laptop with Python):
The laptop serves as the central processing unit of the system. It runs Python scripts that control the entire sorting process. The camera captures real-time frames, which are processed using OpenCV for object recognition. Based on the classification results, the laptop sends signals to the servo motors to execute sorting actions.
Using a laptop as the controller eliminates the need for additional microcontrollers like Arduino or Raspberry Pi, making the system simpler and more efficient.

2.1.6. Python IDE (Programming)

FIG 6 . IDLE

Python code editors are meant to help programmers easily code and debug their programs. Using these Python IDE (Integrated Development Environment), you'll manage an outsized codebase and achieve quick deployment. These editors can be used to create desktop or web applications by developers.

2.1.7. OpenCV

Fig 7. openCV

OpenCV was established to provide standard infrastructure for computer vision applications and to accelerate the use of machine perception in consumer products.
OpenCV was established to provide standard infrastructure for computer vision applications and to accelerate the use of machine perception in consumer products.BSD-licensed software, makes it simple for companies to use and alter the code.

2.2 WORKING MECHANISM
- System Initialization:
- The system starts by initializing the camera and setting up the motor controls.
- Object Detection & Classification:
  • The conveyor belt moves

objects under the laptop camera.

- The camera captures images and processes them to identify object features.
- The software determines the object's category.
- Sorting Process:
- If an object matches Category 1, Actuator 1 is activated to divert it into the appropriate bin.
- If an object matches Category 2, Actuator 2 is activated.
- The same process continues for Category N, where Actuator N handles sorting.
- Control Switch Check:
- If the system is switched on, the process continues.

- If switched off, the system halts, stopping the conveyor belt and motors.

III. RESULT

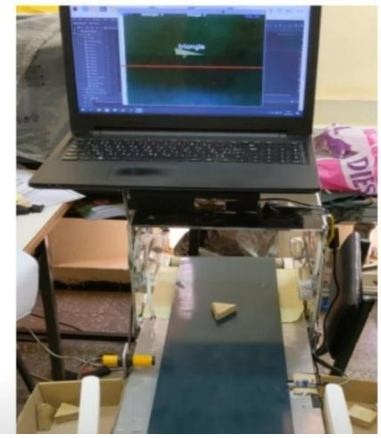

FIG 8. Result

The system effectively identifies and classifies objects moving on a conveyor belt using image recognition. Based on the detected object type, it activates the corresponding actuator to sort the object accordingly. This automated process continues seamlessly until the control switch is turned off, ensuring efficient and accurate sorting with minimal human intervention. The implementation enhances productivity, reduces errors, and optimizes industrial automation for various applications.

IV. FUTURE SCOPE

The future scope of this object sorting system includes AI-based learning for improved recognition, cloud storage for real-time monitoring, and IoT connectivity for remote access. These upgrades will enhance efficiency and automation.

It can be scaled for industrial applications like waste management, food processing, and manufacturing. Future enhancements such as robotic arms, edge AI processing, and faster sorting mechanisms will make it more precise, cost-effective, and efficient.

V. CONCLUSION

The proposed system efficiently automates the object sorting process using image recognition and actuators to classify and separate objects. By utilizing stepper motors, sensors, and a conveyor mechanism, it enhances speed, accuracy, and reliability while minimizing human intervention.

This system has applications in industries like manufacturing, packaging, and waste management. Future improvements, such as AI-based recognition and IoT integration, can further enhance its efficiency and adaptability for more complex sorting tasks.

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