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Automatic Parameter Detection of Gear by Image Processing

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Abstract - Precision measurement of gears plays a vital role in gear measurement and inspection. The current methods of gear measurement are either time consuming or expensive. In addition, no single measurement method is available and capable of accurately measuring all gear parameters while significantly reducing the measurement time. The aim of this paper is to utilize the computer vision technology to develop a non-contact and rapid measurement system capable of measuring and inspecting most of spur gear parameters with an appropriate accuracy. A vision system has been established and used to capture images for gears to be measured or inspected. The introduced vision system has been calibrated for metric units then it was verified by measuring two sample gears and comparing the calculated parameters with the actual values of gear parameters. For small gears, higher accuracy could be obtained and as well as small difference

Key Words: Image-operated sorting machine with conveyor, Motorized conveyor, Programmable Logic Controller (PLC) for conveyor control, Real-time object tracking, Defect detection software (Matlab), Sorting logic and decision module

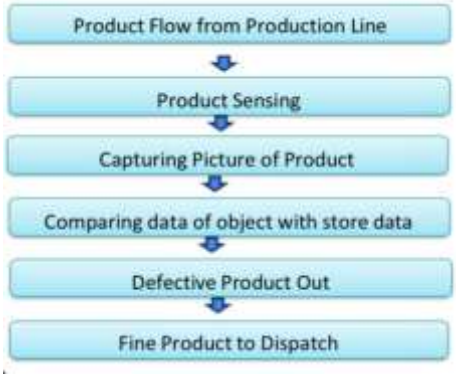
1.INTRODUCTION

Gear is a widely used mechanical component whose primary use is to transmit power from one shaft to other. These gears are of many types namely spur gear, helical gears, worm gears etc. Gear drives are used to various kinds of machines like automobiles, metal cutting tools, material handling equipment, rolling mills, marine power plants etc. The friction and other losses in this type of power transmission equipment is comparatively very low.. In this world of fast paced computation where resources with time and money/capital are very important the activities in manufacturing and processing industries are day by day being performed by computers, algorithms and computing agents replacing human or semi-human intervention. Here in the industries that require gears the filtering and classification of gears is very important and is done by human labor, precisely human labor is limited to its way of working and the time, cost required. Classification can be done with the use of imaging devices, Cameras and scanners with developing an algorithm that describes what to accept and reject.

2. Body of Paper

Methodology

First we will design gear profile error detector suitable to our application. We need to design the conveyor belt taking into consideration the applications and operational conditions. Then we will analyze the design in ANSYS for static and dynamic conditions. Theoretically we will compare basic operational parameter of designed gear profile error detector. By using MATLAB software we will do the programming of the error detector.



Problem identification

Gears have a wide variety of use in mechanical and electrical industries and need to be perfect and flawless with accurate and required number of jaws, diameter, used material , size of jaws, distance between jobs and so on. These all features define the correctness and application in sense where these gears are to be used. This problem of seeing and classifying gears are done by humans but have limitations of speed and accuracy .This responsibility of classification of items can be speeded and made more accurate by the use of imaging technology and computers aided by some mechanical devices.

Requirement Specification

The main objective is to check the gear is error free or not.

To reduce time required for checking

To increase the productivity.

To make sampling method automated.

Detect and classify objects using images

Real-time image processing during conveyor movement

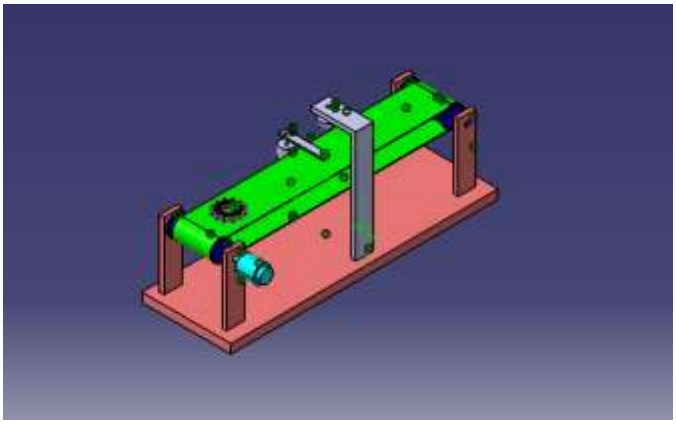
Automatic sorting via actuators (e.g., air jets, pushers)

High sorting accuracy (>95%)

Data logging for performance tracking

Conceptual Design

Material handling is a critical aspect of any manufacturing or production system. An efficient material handling system not only ensures a smooth flow of materials but also directly impacts productivity, safety, and cost-effectiveness. This project focuses on the mechanical and structural design of a material handling system intended to support a gear inspection machine. Several engineering considerations have been applied, including standardization of equipment, use of gravity flow, and optimization of material flow rate and mechanical power.



Fig;Cad model

Material Selection

This project incorporates a variety of key components essential for building a functional robotics or automation system. The major elements include

30RPM 12V DC geared motor,

Flat belt for mechanical transmission,

5MP camera module for image capture

IR sensors for object detection

The L293D motor driver for controlling motor movement

The Arduino UNO microcontroller for central processing.

Together, these components offer a powerful and flexible foundation for building intelligent, responsive robotic systems.

Fabrication

Mechanical Fabrication

Build frame

Install conveyor belt and motor

Mount sorting mechanism (ejector or pusher)

Foam Sheet: Length : 42 cm • Width : 40 cm

Hardware Fabrication

Mount camera and lighting

Connect microcontroller/PLC (e.g., Raspberry Pi or Arduino)

Integrate motor driver, sensors, actuator, power supply

Software Development

- Use OpenCV for image processing
- Detect objects, classify, and trigger actuator
- Create basic user interface (HMI or PC)

Assembly & Calibration

- Align camera and test lighting
- Calibrate sorting logic and response timing

Testing and Evaluation

The testing and evaluation of automatic gear parameter detection using image processing involves capturing clear images of gears with known specifications and processing these images to extract features such as the number of teeth, pitch, and diameter. The detected parameters are then compared to manual measurements or design data to evaluate accuracy through error metrics. To ensure the system's reliability, multiple images of the same gear are tested under varying lighting and angles, and robustness is assessed by analyzing gears with surface defects or partial occlusion. Additionally, the processing time is measured to determine the efficiency of the system for practical use. This comprehensive testing validates the effectiveness of the image processing algorithm for accurate and consistent automatic gear inspection.

Finalization

Upon successful testing the final prototype was documented thoroughly detailing material specification, electrical configuration ,assembly instruction.

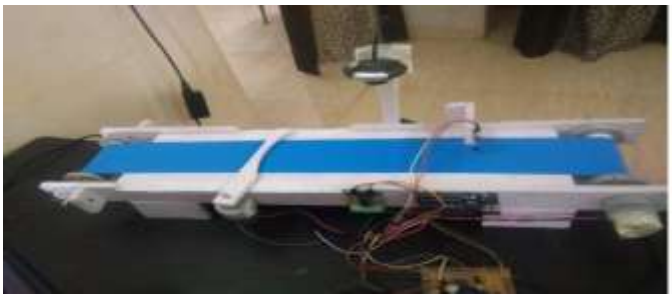
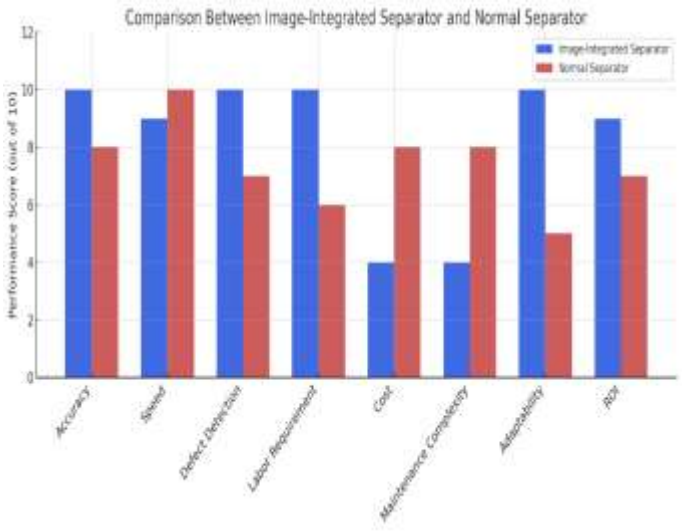


Fig : Fully developed Model

Design Specification

With the integration of mechanical, sensory, and control components, this setup enables efficient motion control, environmental sensing, and decision-making. The combination of Arduino UNO, Foam Sheet: Length : 42 cm Width : 40 cm ,L293D motor driver, and peripherals like IR sensors and camera ensures a robust system for a wide range of robotics applications—from basic movement to advanced automation tasks.

Performance Analysis



FigComparison Between image integrated separator and normal separator

Conclusion

The image-operated separator machine is a practical and efficient solution that combines conveyor automation with computer vision for real-time object sorting. By using a camera and image processing algorithms, the system can accurately detect, classify, and separate items based on visual features like color, shape, or defects.This setup reduces human effort, increases sorting speed, and enhances accuracy. It is suitable for various applications such as agriculture, packaging, and recycling. With affordable components and flexible software, this machine offers a scalable, cost-effective approach to modern automated sorting systems.

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