# How will you present it?

**Literature Review**

Ong Kok Meng [1] investigated a robotic arm system integrated with computer vision for object sorting based on color. The system employed a 5-DOF robotic arm, image processing for object recognition, and a modified flower pollination algorithm for inverse kinematics. Their findings demonstrated successful object detection and sorting based on color. Huang, J [4] presented a comprehensive review of existing methods for identifying and monitoring the loosening of threaded fasteners. They classified the methods into three categories: sensor-based, vision-based, and percussion-based. [8] introduced a Deep CNN architecture to assist in image classification. Their Convolutional Neural Network was trained on the extensive ImageNet dataset, encompassing various images that facilitated its learning process. The results demonstrated the network's effectiveness in image classification tasks. Xu, Z.-D. Zhang, Y. Manikandan, R. [12] explained a vision-based solution for detecting missing fasteners on rail track images using a support vector machine (SVM) classifier. This method first segmented the fasteners in the images and then extracted features like shape, size, and texture before using an SVM classifier to identify missing or present fasteners. The results showed the method's effectiveness in detecting missing fasteners. Gong, H. [13] proposed a computer vision integrated deep learning system to detect and count loosening of threaded fasteners. The method used a deep learning model to identify nuts and bolts and then geometric imaging theory to measure nut rotation angles. Their R-CNN based approach achieved accurate detection and identification of loosening. Yuan, C. [14] proposed a near real-time bolt-loosening detection method. Their R-CNN, trained on a dataset of bolt images with different loosening degrees, achieved accurate real-time bolt loosening detection. Pham, H.C. [15] introduced a novel approach for monitoring bolt loosening, combining image-based deep learning for nut and bolt detection with a graphical model to track their movement over time. Their framework proved effective in monitoring bolt loosening. Sun, Y. [16] proposed a machine vision method for bolt loosening using YOLOv5, a real-time object detection algorithm. The model, trained with images of bolts exhibiting different loosening degrees, achieved accurate real-time bolt loosening detection. Espinosa Peralta [20] explored the development of a vision system for fastener detection and localization. This system leveraged cameras and diverse image processing algorithms to achieve accurate identification and positioning. The article also emphasized the importance of socket wrenches, camera calibration, active NIR illumination, segmentation neural networks, and image augmentation for enhancing system robustness. Wei, X [21] focused on developing automatic inspection methods for railway track fasteners using image processing, computer vision, and machine learning. The paper discussed various algorithms employed and the evaluation process using standard performance metrics. However, it lacked details on the specific hardware used. usli, L. and Luscher, A. [22] discussed the application of machine vision technology for fastener identification and verification during assembly processes. This technology, utilizing cameras and recognition software, offered reliable verification by identifying unique features around fasteners, potentially eliminating the need for torque checks and reducing assembly costs. While the study demonstrated its reliability under simulated lighting, it did not explore industrial camera hardware. Sága, M., et al. [23] analyzed the development and performance of a robotized screwing application with an integrated vision system for the automotive industry. The article highlighted the crucial role of technical equipment, precise condition analysis, and engineering expertise for successful implementation. It emphasized the vision system's role in providing data on part shape and position and discussed the importance of selecting appropriate light sources and filters. Finally, it concluded by underscoring the integration of various systems in automated manufacturing lines. K., Köcher, S., et al. [24] envisioned a future factory transformed by technological advancements. This transformation would involve replacing rigid layouts and human-intensive processes with driverless transport systems and dexterous robots capable of complex tasks and data collection. The article envisioned seamless collaboration between humans and robots, streamlining production while ensuring safety. Lee, D., et al. [27] presented a robot with 2D vision and a gripper, controlled by a PLC, for inspecting and removing defective products on a conveyor belt. While achieving 95% accuracy on test pieces, it required further development to handle real-world variations and wider defect types. This research demonstrated the potential of integrating robots, vision, and PLCs for improved quality and productivity in manufacturing. Abhijith, V. S.[31] discussed the use of AprilTag markers in robotic applications. This marker system, utilizing barcodes, allowed for obtaining 6 DOF localization features from a single image. The paper described the experimental setup and highlighted the benefits of using AprilTag markers in robotic applications. Li et al. [32] investigated the autonomous landing of drones and the challenges faced in GPS-denied environments. The paper proposes an onboard solution for the drone using the AprilTags visual positioning algorithm based on monocular vision. The paper also addresses issues such as motion control, target detection, and system communication. The AprilTags algorithm is used to locate and estimate the attitude of the UAV, and the drone can locate accurately at different altitudes by setting different sizes of the tags as the landing target. The paper concludes that the proposed method has good landing performance and tracking accuracy. Riedel et al. [33] proposed a deep learning-based worker assistance system for manual assembly. The study aims to provide architectural and implementational details of a state-of-the-art assembly assistance system based on an object detection model. The proposed system can prevent 51% of the assembly errors compared to a control group without the use of assistance. The study also discusses how the collected data can further be used as valuable sources of information. The research is relevant for different kinds of products due to the diversity of assembly processes, materials, and part sizes. The proposed architecture is intended to be representative of modern assistance systems. The paper concludes that the proposed assembly assistance system does not affect the worker in any undesirable way. Yu et al. [34] proposed a single moving object detection and recognition, which is an important branch of image processing and computer vision. The paper proposes an improved Frequency-tuned (FT) algorithm combined with the pre-background separation algorithm based on the mixture Gaussian model to extract dynamic significant information. The paper also discusses the use of the visual attention mechanism to detect objects that may cause visual attention and mark them as a highlight area. The proposed architecture is intended to be representative of modern assistance systems. The paper concludes that the proposed method has significant effects on the detection and recognition of single-target motion and has high accuracy, and it has a good engineering application prospect. Hercog et al. [35] developed a product assembly assistance system based on Pick-To-Light (PTL) modules. The enclosure of the PTL modules is made of a PLA compound using a 3D printer. The system is scalable and can easily be upgraded to a larger number of modules. The paper also discusses the concepts of Cyber-Physical Systems (CPS), Internet of Things (IoT), and cloud computing. The proposed system is useful in the case of the assembly process of complex products containing a large number of components. The paper concludes that the proposed assembly assistance system is designed to be universal and does not affect the worker in any undesirable way. [36] explores a product assembly assistance system based on Pick-To-Light (PTL) modules. The enclosure of the PTL modules is made of a PLA compound using a 3D printer. The system is scalable and can easily be upgraded to a larger number of modules. 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The Structural Similarity Index Method (SSIM) is used to measure the data loss caused by downscaling. The paper provides a detailed explanation of the Canny Edge Detection method and the SSIM index function.[38] proposed a Computer Vision (CV), which is concerned with enabling computers to comprehend images. The paper explains that CV aims to create techniques that allow computers to "see" and interpret the content of digital pictures like photographs and movies. The paper also discusses the challenges of CV, including a lack of understanding of biological vision and the complexity of vision perception. The paper explores various applications of CV, such as creating surveillance-based simple applications and more advanced AI integrated applications that can use machine learning to implement tasks such as facial recognition, emotion detection, and object detection. The paper also discusses image segmentation, which is the process of dividing an image into sections to extract the target of interest. The paper concludes by suggesting that there are many topics that can be investigated further, such as improving methodologies to suit various problem-specific or domain-specific applications and implementing more helpful methods and algorithms to improve procedures. Lynn et al. [39] explores edge detection, which is a process used in image processing and computer vision to capture useful properties of objects and images. The paper discusses the two major categories of edge detection methods, search-based and zero-crossing based methods, and the steps involved in edge detection, including filtering, enhancement, and thresholding. The authors compare the Canny and Sobel algorithms for edge detection and analyze the results obtained from each algorithm. The paper concludes by discussing the importance of real-time edge detection in various fields of life. Darvishi [40] compares algorithms used for object tracking and detection. The article discusses various algorithms such as the MIL tracker, TLD tracker, and BOOSTING tracker, and explains how they work. The article also introduces the concept of IoU evaluation criteria, which is used to assess the performance quality of the algorithms. The article emphasizes the importance of accurate object tracking and detection in various fields, such as surveillance and robotics. The article's key points include the advantages of using System on Chip (SoC) in mobile and portable systems, the importance of appearance models in predicting the position of an object, and the significance of reducing the number of chips on a computer board to yield a compact size. Overall, the article provides valuable insights into the world of object tracking and detection and highlights the importance of using accurate algorithms for these tasks. Abdulhamid et al. [41] presented a computer vision system based on Raspberry Pi. The system uses Python programming language and OpenCV software to detect and count objects within a target area. The paper explains the factors that affect the system's reliability, such as the number of objects within an image, the background color, the distance between objects, the shadow of objects, and the distance from the camera's lens to the specimen. The paper also describes the hardware components used in the system, including the Pi camera, Ethernet cable, and micro-USB 5 V 700 mA. The paper concludes by highlighting the potential of the Raspberry Pi-based system and its ability to differentiate between objects in an image based on their shapes.

**Results**

Accuracy

How much time is reduced with this?

How is it benefitting the industry?

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