Improving Authorization With Colour-based ID Card Detection

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Abstract –ChromaCard represents an automated apparatus designed for the authentication of access to a given location based on the coloration of an individual's ID card tag. In contrast to conventional systems reliant upon ID card readers, which necessitate manual interaction to present the tag to the device, our innovative robotic solution excels in seamlessly detecting tag colours even when in motion. Employing a sophisticated camera equipped with object detection capabilities, the robotic entity rigorously scrutinizes the hues of the ID tag. Subsequently, it cross-references this data with a comprehensive repository of validated ID cards authorized for entry to the specified location at the given moment. The determination of an individual's entitlement to access is thereby made, leading to one of two outcomes: should authorization be affirmed, the robotic system proceeds to assess the subsequent ID card; conversely, if access is denied, it promptly dispatches a notification to the student care administrator, who is near the facility.

Keywords: Chromacard, Access control, Authentication, Coloration, Hues conventional system, Motion detection, ID card

I. Introduction

In today's rapidly evolving world, security and access control play pivotal roles in safeguarding various physical and digital spaces. The conventional approach to access control predominantly relies on identification card readers, a ubiquitous technology employed in educational institutions, corporate facilities, and a wide array of secured environments. However, the efficacy of these traditional systems hinges on manual user interaction, which not only leads to bottlenecks in high-traffic areas but also introduces the possibility of human error. The need for a more efficient, accurate, and automated solution to address these challenges has never been more pronounced.

In response to this imperative, we introduce "ChromaCard," an innovative and autonomous system designed to redefine access authorization through the utilization of colour-based identification card detection.

II. Methodology

a. Object detection:

Object detection is a computer vision task that involves identifying and locating objects of interest within an image or video frame. The goal is to not only determine what objects are present but also to provide precise bounding boxes around them. Object detection has numerous practical applications, including autonomous vehicles, surveillance systems, facial recognition, and robotics.Object detection has evolved significantly with the advent of deep learning techniques, particularly Convolutional Neural Networks (CNNs). Modern object detection models like YOLO [1](You Only Look Once), Faster R-CNN, and Mask R-CNN have achieved impressive accuracy and real-time performance, making them suitable for a wide range of applications.

YOLOv4-tiny is a variant of the YOLO (You Only Look Once) object detection model, which is known for its real-time performance and high accuracy. YOLOv4-tiny is designed to provide a lightweight and faster version of YOLOv4 while maintaining the ability to detect and locate objects accurately in images and video frames.[1]

b. Image Processing:

Image processing refers to the manipulation and analysis of images using computer algorithms and techniques. It involves applying various operations to digital images to enhance their quality, extract useful information, or perform specific tasks. Image processing plays a critical role in a wide range of applications, including computer vision, medical imaging, remote sensing, and multimedia.

Image processing is a multidisciplinary field that combines principles from computer science, mathematics, and engineering. It continues to advance with the development of more sophisticated algorithms, hardware acceleration, and the integration of artificial intelligence techniques, enabling a wide range of applications in various industries.

These are the types of image processing:

- <u>Visualization</u> - Find objects that are not visible in the image

- Recognition - Distinguish or detect objects in the image
- Sharpening and restoration - Create an enhanced image from the original image
- Pattern recognition - Measure the various patterns around the objects in the image
- Retrieval - Browse and search images from a large database of digital images that are similar to the original image

c. Tracking Object :

Object tracking is a computer vision task that involves locating and following objects or targets within a video sequence as they move over time. Tracking objects is an essential component of various applications, including surveillance, autonomous vehicles, human-computer interaction, and robotics.

There are several algorithms are used in object tracking.They are as follows:

Mean-Shift: An iterative method that updates the position of the object's centroid based on the distribution of pixel values.[4]

CamShift:The CamShift algorithm, short for "Continuously Adaptive Mean Shift," is a computer vision technique used for object tracking in video sequences. CamShift is an extension of the Mean Shift algorithm and is particularly well-suited for tracking objects whose appearance and scale may change over time, making it a robust choice for tracking objects with complex motion and occlusions.[6]

Kalman Filter: A recursive estimation algorithm that predicts and corrects the object's state over time.

Correlation Filters: Methods that use filters to find the object in the next frame by maximizing the correlation between the object template and image patches.

d. Colour Detection:

Color detection is a computer vision and image processing task that involves identifying and analyzing specific colors or color ranges within images or videos. This process is widely used in applications such as object recognition, quality control, image segmentation, and more.Here are common techniques and methods for color detection:

Color Spaces:

Different color spaces, such as RGB, HSV (Hue, Saturation, Value), LAB, and YUV, represent colors in different ways. Choosing the appropriate color space can simplify color detection based on the specific task and characteristics of the image.

Thresholding:

Thresholding involves setting a threshold value for each color channel in an image. Pixels with color values within the specified range are considered part of the target color, while others are ignored.

Machine Learning and Deep Learning:

Machine learning models, such as support vector machines (SVMs) or convolutional neural networks (CNNs), can be trained to perform color detection tasks. Deep learning models can learn color patterns and features from large datasets.

Template Matching:

Template matching compares a reference color template to image regions to identify matching colors. It is useful for finding specific colors or color patterns.

Color detection methods are versatile and widely applicable in fields such as computer vision, robotics, manufacturing, and entertainment. The choice of method depends on the specific color detection task and the characteristics of the images or videos being processed.

III. Conclusion

This paper reviewed techniques in building ChromaCard collectively to form a highly sophisticated and dependable access control and authentication system. By integrating color-based authentication, motion detection, advanced camera technology, data cross-referencing, and immediate notification, ChromaCard enhances security, user convenience, and operational efficiency in comparison to traditional ID card reader systems.

Overall,it offers a solution suitable for a wide range of environments, promising to redefine access control and authentication in an increasingly dynamic and security-conscious world.

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