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Review Article

Track Vision Real Time Obstruction Detection and Pedestrian Alert System

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Abstract

The advancement of computer vision and deep learning technologies has ushered in a new era of innovation by entering the railway industry. Traditional train control systems rely on fixed infrastructure and human operators, which can be inflexible and prone to errors. A new age technological solution for problems faced in efficient railway transportation is in need that also safeguards the passenger's life. One such approach is this project that helps ai assisted driving of passenger trains using computer vision along with deep learning for efficient decision makings and prevent negligence of loco pilot resulting in life risks. This project contains the design, implementation, and testing of a robust system that can detect obstacles on the track, pedestrians crossing the track and effective decision-making system that can decide any collision or pedestrian accidents enabling loco pilots to make informed decisions about when and where to apply emergency breaks etc. The integration of computer vision technology enables real-time data acquisition, and deep learning algorithms empower trains to adapt to dynamic and complex environments. Improved safety, reduced human error, increased operational efficiency, and enhanced scheduling flexibility are some of the key advantages. While exploring the applications of AI in the field of railways this approach can subsequently help the railway authorities to enable the existing safety system "Kavach" and implement it to safeguard citizens at risk.

Keywords: Computer vision, Deep learning, Railway industry, Traditional train control system, AI assisted driving, Obstacle detection, Pedestrian detection, Decision-making system, Emergency braking.

I. INTRODUCTION

The railway sector is undergoing a significant transformation driven by the integration of computer vision and deep learning technologies. Traditional train control systems, which rely on fixed infrastructure and human operators, often face limitations such as inflexibility and errors. To tackle these challenges and ensure efficient transportation and passenger safety, there is an urgent need for innovative technological solutions. The advancement of computer vision and deep learning has opened up new avenues of innovation within the railway industry. A solution is required to address issues in efficient railway transportation and ensure passenger safety. This project involves designing, implementing, and testing a robust system capable of detecting track obstacles and pedestrians. It also includes the development of an effective decision-making system to prevent collisions and pedestrian accidents, enabling train operators to make informed decisions about emergency braking. By leveraging computer vision and deep learning technologies, this project aims to enhance decision-making capabilities and reduce the risk of accidents caused by negligence or unexpected obstacles on the tracks. The project focuses on creating an AI driven decision-making process, providing real-time information and insights to train operators to prevent accidents. Through this project, the aim is to explore the potential of AI applications in railway transportation, particularly in improving safety protocols and operational efficiency. The successful integration of computer vision and deep learning holds the promise of revolutionizing the railway industry, ensuring safer and more reliable transportation systems in the future.

II. LITERATURE SURVEY

A. COMPUTER VISION AND IMAGE PROCESSING: A PAPER REVIEW

Computer vision, an interdisciplinary field merging digital image processing, pattern recognition, machine learning, and computer graphics, has captured the attention of researchers from various backgrounds. This comprehensive review aims to delve into the multifaceted world of recent technologies and theoretical frameworks shaping the evolution of computer vision, with a primary focus on image processing applications in diverse domains. Essentially, computer vision facilitates the analysis of images and videos to extract valuable information, comprehend intricate event details, and identify complex patterns. Employing a wide array of methodologies, these tasks require extensive data analysis and computational techniques. By synthesizing recent advancements in computer vision, image processing, and related studies, this paper seeks to contribute to the ongoing understanding of this rapidly evolving field. The exploration of computer vision is categorized into four main domains: image processing, object recognition, machine learning, and computer graphics. Each domain encompasses its unique set of methodologies, algorithms, and applications, enriching the diverse landscape of computer vision research. Through a systematic examination of these domains, this paper aims to provide valuable insights into the current state of the art techniques and their performance across various application domains. Moreover, the paper presents nuanced perspectives on contemporary approaches, shedding light on their strengths, limitations, and potential avenues for future research. By synthesizing a broad range of literature and empirical findings, this review paper aims to offer a comprehensive overview of recent advancements and emerging trends in the field of computer vision. In summary, this review paper serves as a valuable resource for researchers, practitioners, and enthusiasts seeking a deeper understanding of the evolving landscape of computer vision, image processing, and related disciplines. Through its meticulous examination of recent developments and theoretical frameworks, this paper aims to inspire further inquiry andinnovation in this exciting field.

B. YOLOv4: OPTIMAL SPEED AND ACCURACY OF OBJECT DETECTION

In the domain of Convolutional Neural Networks (CNNs), where attaining high accuracy on expansive datasets is paramount, the exploration of various combinations of features is of significant importance. These features not only aim to boost model performance but also contribute to our theoretical comprehension of CNN dynamics. While some features may be tailored to specific models or datasets, others, like batch normalization and residual connections, offer broad applicability across diverse CNN architectures, tasks, and datasets. Among the features widely believed to enhance performance universally are Weighted Residual Connections (WRC), Cross-Stage-Partial-connections (CSP), Cross Mini-Batch Normalization (CmBN), Self-adversarial training (SAT), and Mish activation. These features have shown their effectiveness in bolstering model resilience and generalization, thus becoming integral components of contemporary CNN architectures. In our study, we extend beyond traditional feature sets by integrating novel enhancements such as WRC, CSP, CmBN, SAT, Mish activation, Mosaic data augmentation, Drop Block regularization, and CIoU loss. Through the meticulous combination of these features, we achieve outstanding results, as evidenced by a state of the-art average precision of 43.5By incorporating these advanced features into our CNN architecture, we not only push the performance boundaries but also pave the way for deeper insights into the underlying mechanisms governing CNN behavior. This study underscores the critical role of feature engineering and emphasizes the potential for further advancements in the domains of deep learning and computer vision.

C. A COMPUTER VISION SYSTEM FOR DETECTION AND AVOIDANCE FOR AUTOMOTIVE VEHICLES

The paper introduces an innovative vision based algorithm designed for obstacle detection and avoidance in autonomous land vehicles, a pivotal aspect of autonomous vehicle technology. The algorithm hinges on a thorough comprehension of the vehicle's surrounding environment, forming the bedrock for informed decision-making and secure navigation. A core aspect of the algorithm involves segmenting the environment into two distinct categories: obstacles and clear paths. This segmentation enables the identification of available space for obstacle avoidance maneuvers, facilitating safe navigation through the vehicle's surroundings. By categorizing the environment in this manner, the algorithm can prioritize obstacle free areas, enabling the vehicle to chart its course accordingly. Data collection plays a fundamental role in the algorithm's operation, with a high-resolution digital camera employed to capture images of the vehicle's surroundings. These images serve as the primary input for the algorithm, providing the visual data necessary for obstacle detection and path planning. Through advanced image processing techniques, the algorithm extracts pertinent features from the captured images, facilitating the estimation of critical parameters essential for obstacle avoidance. The algorithm estimates various parameters from the collected data, including the relative distance and dimensions of obstacles, as well as the vehicle's turning radius and required steering angle for avoidance maneuvers. These parameters offer valuable insights into the spatial layout of the environment and the geometric relationships between the vehicle and surrounding obstacles. By accurately estimating these parameters, the algorithm can make informed decisions regarding the most appropriate actions to avoid collisions and ensure safe navigation. The algorithm's effectiveness stems from its ability to utilize real-time visual data to adaptively respond to dynamic changes in the environment. Continuously analyzing incoming imagery as the vehicle progresses, the algorithm detects and evaluates potential obstacles in its path. This proactive approach enables the vehicle to anticipate and react to obstacles in real-time, executing timely and efficient avoidance maneuvers. In summary, the vision based algorithm outlined in the paper represents a significant advancement in autonomous vehicle technology. By integrating sophisticated image processing techniques with intelligent decision-making algorithms, the algorithm empowers autonomous land vehicles to navigate complex environments safely and effectively. As autonomous vehicle technology evolves, algorithms like this will be instrumental in facilitating their widespread adoption and integration into everyday transportation systems.

D. COMPUTER VISION BASED OBSTACLE IDENTIFICATION USING REAL-TIME ILLUMINATION SENSOR DATA

This study describes the creation of an Internet of Things (IoT) system aimed at monitoring obstacles on indoor surfaces using mobile sensors within a client-server wireless network structure. The system integrates an IR transceiver for capturing positional data and a light intensity sensor for measuring lux values. At its core, an embedded Wi-Fi enabled microcontroller functions as the client system, installed on the roof of a vehicle. As the vehicle moves through indoor spaces, the client module collects positional and illumination data, which is then transmitted to the server unit. Sensor readings are stored on a server laptop in MS-Excel format via a Wi-Fi router. Offline processing techniques are utilized to convert real-time sensor data into images, employing filtering methods to reduce linear and nonlinear noise. Subsequently, various edge detection algorithms, including Canny, Prewitt, Sobel, and Robert's methods, are applied to identify obstacles. To evaluate the effectiveness of obstacle detection methods, the experiment is replicated in another room. The results demonstrate that the Canny algorithm offers the most accurate identification of static obstacles in both environments. Overall, this study presents the development and deployment of an IoT-based obstacle monitoring system for indoor environments. It demonstrates the integration of mobile sensors, wireless communication, and image processing techniques. Through systematic experimentation, the study underscores the effectiveness of the Canny algorithm in precisely detecting obstacles, offering valuable insights for future applications in obstacle detection systems.

E. DEVELOPMENT OF COMPUTER VISION BASED OBSTACLE DETECTION AND HUMAN TRACKING ON SMARTWHEELCHAIR FOR DISABLED PATIENT

Individuals with physical disabilities such as quadriplegia often require assistance with mobility. Smart wheelchairs represent a notable advancement from traditional models, as they are equipped with sensors, cameras, and a computer based system serving as the central processing unit, enabling intelligent functionalities. In our study, we have developed a smart wheelchair system that integrates obstacle detection and human tracking capabilities using computer vision techniques. Our experimental results demonstrate impressive performance in obstacle distance estimation, particularly with the implementation of the RANSAC method. Compared to a slightly higher average error of 2.508 cm observed with linear regression, the RANSAC method achieves an average error of only 1.076 cm, highlighting its superior accuracy in determining obstacle distances. Furthermore, our algorithm for human guide detection achieves a commendable average accuracy rate exceeding 80By incorporating these advanced functionalities into a smart wheelchair system, our aim is to significantly enhance the mobility and independence of individuals with physical disabilities. Our research underscores the potential of computer vision technologies in transforming assistive devices and emphasizes the importance of accuracy and reliability in obstacle detection and human tracking capabilities for suchsystems.

F. APPLICATION OF COMPUTER VISION AND DEEP LEARNING IN THE RAILWAY DOMAIN FOR AUTONOMOUS TRAIN STOP OPERATION

The paper explores the utilization of Deep Learning in the railway industry, with a specific emphasis on enhancing train stop operations. It introduces a novel approach that combines monocular vision based methods with Deep Learning architectures to tackle the challenges associated with railway localization. A significant insight presented in the paper is the potential of Deep Learning architectures to address obstacles in railway operations, despite the strict regulatory environment. By employing techniques such as visual odometry, Simultaneous Localization and Mapping (SLAM), and pose estimation, Deep Learning shows promise in improving the efficiency and safety of train stop operations within railway systems. Another notable aspect highlighted in the paper is the absence of tailored datasets for training neural networks in indoor railway environments. This gap underscores the necessity for developing a new dataset specifically tailored to address the unique challenges encountered in railway settings. Such a dataset would enable more accurate training of Deep Learning models, ultimately enhancing their performance in real-world railway applications. Additionally, the paper outlines various directions for future research and development in railway applications, providing valuable insights and guidance for upcoming endeavors. By pinpointing areas for improvement and innovation, such as enhancing the robustness of Deep Learning models in railway environments and devising new techniques to navigate regulatory constraints, the paper plays a pivotal role in shaping the trajectory of research initiatives in the field. In summary, this paper delivers a comprehensive analysis of Deep Learning's potential in the railway sector, particularly in optimizing train stop operations. Through its innovative approach and emphasis on the importance of tailored datasets and ongoing research efforts, the paper makes significant contributions to advancing railway technologies andsystems.

G. IOT BASED VEHICLE TRACKING AND MONITORING SYSTEM USING GPS AND GSM

In recent years, there has been a significant increase in the adoption of vehicle tracking systems, primarily due to the growing demand for improved security measures, especially in preventing vehicle theft. The primary aim of the proposed system is to deploy an anti-theft mechanism, which serves as an additional safeguard for vehicles. These systems offer a wide array of benefits, not limited to just theft prevention, but also encompassing security enhancements for various types of vehicles such as personal vehicles, taxis, cabs, school buses/cars, and others. At the heart of the vehicle tracking system lies the integration of GPS (Global Positioning System) and GSM (Global System for Mobile Communications) modules, which facilitate the provision of real-time positioning information for the vehicle. The GPS module operates by continuously tracking the vehicle's location and providing precise coordinates like latitude and longitude. These coordinates are then relayed to the user through a GSM modem via the mobile network, enabling convenient and accurate tracking of the vehicle's whereabouts at any given moment. In addition to tracking the vehicle's location, the system incorporates various sensors designed to detect potential incidents such as driver alcohol consumption or vehicle accidents. These sensors play a crucial role in monitoring the vehicle's surroundings and ensuring the safety of both passengers and pedestrians. Moreover, sensor data can be monitored globally through a Thing Speak channel, offering users comprehensive insights into the vehicle's status and potential risks. To further enhance security, RFID (Radio Frequency Identification) technology is integrated into the vehicle tracking and anti-theft system. An ignition key equipped with RFID technology is utilized to detect any unauthorized access or attempted theft. In case of theft detection, users can remotely access a GSM control app to manage and control the vehicle, potentially aiding in its recovery and preventing further damage. Overall, the proposed vehicle tracking system presents a comprehensive solution for detecting and preventing vehicle theft, while also offering additional security features and functionalities. By leveraging GPS, GSM, sensor technology, and RFID, the system ensures efficient and effective vehicle monitoring, thereby contributingto heightened safety and peace of mind for both vehicle ownersand users.

H. AUTOMATIC OBSTACLE DETECTION METHOD FORTHE TRAIN BASED ON DEEP LEARNING

Ensuring the safety of train operations is of utmost importance, and automatic obstacle detection systems play a vital role in achieving this objective. However, current fully automatic train operation (FAO) systems often rely primarily on signaling controls and lack additional equipment for environmental perception. To bridge this gap and improve the efficiency and safety of FAO systems, this study proposes an intelligent obstacle detection system utilizing advanced deep learning techniques. The proposed system aims to collect perceptual data from industrial cameras and Light Detection and Ranging (LiDAR) sensors, focusing on three key areas: rail region detection, obstacle detection, and visual-LiDAR fusion. Deep Convolutional Neural Network (CNN) algorithms are employed for tasks such as semantic segmentation and object detection, enabling precise identification of the rail track area ahead and the detection of potential obstacles on the track. During the rail region detection phase, the system utilizes CNNs to accurately outline the boundaries of the rail track, providing a comprehensive understanding of the railway environment. This serves as a crucial foundation for subsequent obstacle detection tasks. Through sophisticated object detection algorithms, the system can effectively identify and categorize obstacles present on the track, such as debris, fallen objects, or obstructions. The visual-LiDAR fusion module combines data from both visual cameras and LiDAR sensors. This integration enables the system to perceive the environment under various weather conditions and accurately determine the geometric relationship between the track and obstacles. By integrating visual and LiDAR data, the system can promptly trigger a warning alarm when necessary, alerting train operators to potential hazards on the track. Experimental results demonstrate the exceptional performance and robustness of the proposed system, achieving an impressive perception rate (precision) of 99.994.

I. AN INTELLIGENT DEPTH BASED OBSTACLE DETECTION SYSTEM FOR VISUALLY-IMPAIRED AID APPLICATIONS

This paper introduces a robust obstacle detection system that utilizes depth information in computer vision, aiming primarily to aid visually-impaired individuals in identifying obstacles for enhanced safety. Through the analysis of depth maps, the system employs segmentation and noise reduction techniques to differentiate between various objects based on their depth information. Additionally, the paper presents an obstacle extraction mechanism designed to identify obstacles by analyzing different object properties observed in the depth map. The proposed system shows promising potential for application in emerging vision based mobile technologies, including robot navigation, intelligent vehicle guidance, and dynamic surveillance systems. By leveraging depth information, the system enhances its ability to detect obstacles, thereby improving the efficiency and safety of various applications. Experimental results validate the effectiveness of the system, demonstrating its high accuracy in obstacle detection. In indoor environments, the system achieves an average detection rate exceeding 96.1In conclusion, the obstacle detection system presented in this paper, which relies on depth information, offers a promising solution for assisting visually-impaired individuals and enhancing safety in various settings. Its capability to accurately detect obstacles in diverse environments underscores its potential for real-world implementation in vision based mobile technologies, paving the way for improved navigation, guidance, and surveillance systems.

J. OBJECT DETECTION USING DEEP LEARNING, CNNS AND VISION TRANSFORMERS: A REVIEW

Object detection poses a fundamental challenge within the domain of computer vision and image comprehension, serving as a pivotal component across various applications. Recent advancements in this field have been significant, largely driven by improvements in object representation and the widespread adoption of deep neural network models. This paper under takes an extensive exploration of the evolution of object detection, focusing particularly on the era marked by the dominance of deep learning techniques. A comprehensive literature review is conducted, spanning a wide array of state of the art object detection algorithms. These algorithms are meticulously analyzed to elucidate the underlying principles and methodologies that contribute to their effectiveness. They are categorized into three main groups: anchor based, anchor free, and transformer based detectors, each employing unique approaches to identify objects within images, showcasing the diverse landscape of object detection methodologies. Throughout the survey, each algorithm's rationale is thoroughly examined, providing insights into the intricacies of their design and functionality. Additionally, the paper presents empirical analyses aimed at comparing various metrics such as quality, speed/accuracy tradeoffs, and training methodologies across different object detection algorithms. This empirical evaluation allows for a deeper understanding of the strengths and weaknesses inherent in each approach, empowering researchers and practitioners to make informed decisions regarding algorithm selection and deployment. Moreover, the survey offers a comprehensive comparison of major convolutional neural networks (CNNs) that are commonly utilized for object detection tasks. By evaluating the performance of these CNN architectures in conjunction with various detection algorithms, the paper delineates the landscape of available options and their respective capabilities. Crucially, the discussion extends beyond mere performance metrics to encompass a nuanced examination of the strengths and limitations associated with each object detection model. By critically assessing these aspects, the survey provides valuable insights into the practical implications of adopting specific algorithms in real-world scenarios. In essence, this paper serves as a roadmap for navigating the complex terrain of object detection algorithms in the era dominated by deep learning. Through a synthesis of extensive literature and empirical findings, it offers a comprehensive overview of the field, equipping researchers and practitioners with the knowledge needed to make informed decisions and drive further advancements in object detection technology.

K. OBJECT DETECTION USING YOLO ALGORITHM INCONVOLUTION NEURAL NETWORK

In the field of computer vision, the task of recognizing and locating objects within images or videos is highly coveted due to its wide applicability. To fulfill this demand, a variety of algorithms have been developed, each offering unique strengths and methodologies for object detection. Notable examples include Region based Convolutional Neural Networks (RCNN), Fast Region based Convolutional Neural Networks (FRCNN), and the You Only Look Once (YOLO) technique. Within this context, the YOLO V3 algorithm emerges as a particularly promising solution for object detection tasks. The YOLO algorithm, which stands for You Only Look Once, has gained significant traction in computer vision circles owing to its efficiency and accuracy in real-time object detection. Unlike traditional methods that involve multiple stages such as region proposal and classification, YOLO treats object detection as a single regression problem, directly predicting bounding boxes and class probabilities for objects within an image. A primary advantage of the YOLO algorithm lies in its speed and efficiency. By processing the entire image in one go through the neural network, YOLO achieves real-time object detection, making it well suited for applications necessitating swift processing, such as video surveillance, autonomous driving, and augmented reality. Implementation of the YOLO algorithm typically entails leveraging programming languages like Python and libraries such as OpenCV. Python offers a flexible and user-friendly environment for developing computer vision applications, while OpenCV provides a comprehensive suite of tools for image processing and analysis. Empirical evaluations have demonstrated that the YOLO algorithm outperforms other techniques in object detection tasks. Its ability to accurately locate and classify objects across diverse shapes, sizes, and orientations has been validated through various experiments and benchmarking studies. Moreover, the YOLO algorithm offers flexibility in model architecture and configuration, enabling users to fine tune parameters and optimize performance for specific applications or environments. This adaptability renders YOLO a versatile tool suitable for a wide array of tasks and scenarios. In conclusion, the YOLO algorithm stands as a potent and efficient solution for object detection in computer vision applications. Its capability to swiftly and precisely identify objects in images or videos renders it invaluable across a spectrum of tasks, ranging from surveillance and security to industrial automation. With its simplicity, speed, and effectiveness, YOLO remains a popular choice among researchers and practitioners in the field of computer vision.

L. OBJECT DETECTION AND TRACKING USING YOLO

In recent years, there has been widespread adoption of Artificial Intelligence (AI) across various sectors, with deep learning emerging as a key driver of progress. This paper explores the domain of deep learning and its role in object detection and tracking tasks. Deep learning, inspired by the structure and functioning of the human brain, has transformed AI by enabling algorithms to learn from extensive datasets and extract intricate patterns and features. A major advantage of deep learning algorithms is their ability to continually improve with increasing amounts of data. Unlike conventional learning algorithms, which often reach a performance plateau as data volume grows, deep learning algorithms maintain their accuracy and effectiveness as they are exposed to more data. This adaptability makes deep learning particularly suited for challenging tasks such as object detection and tracking. Real-time object tracking has emerged as a significant area of focus within computer vision applications. Despite notable advancements, achieving high levels of accuracy and reliability in real-time object tracking remains a significant challenge. Detection and tracking algorithms are vital components of systems designed for security, surveillance, and inspection purposes, necessitating robust methodologies for extracting features from images and videos. Various algorithms have been developed for object detection, including notable examples such as You Only Look Once (YOLO), Region based Convolutional Neural Networks (RCNN), and Faster RCNN (FRCNN). Each algorithm offers distinct advantages and trade-offs in terms of accuracy and processing speed. While RCNN typically delivers superior accuracy, YOLO excels in speed, making it well suited for applications requiring real time processing. YOLO approaches object detection as a regression problem, wherein the algorithm predicts bounding boxes and class probabilities directly from the input image. This streamlined approach enables YOLO to achieve rapid and efficient object detection, making it suitable for scenarios demanding immediate processing. Despite the strengths of deep learning algorithms like YOLO, challenges persist in achieving high levels of accuracy and robustness in real-time object tracking. These challenges arise from environmental complexities, variations in lighting conditions, occlusions, and other factors that can impact the performance of detection and tracking algorithms. In conclusion, this paper underscores the significance of deep learning in object detection and tracking applications. By leveraging advanced algorithms such as YOLO, researchers and practitioners can enhance the efficiency and effectiveness of real-time object tracking systems, thereby advancing security, surveillance, and other critical domains. Nevertheless, ongoing research and innovation are essential to address remaining challenges and further refinethe performance of object detection and tracking algorithmsin practical scenarios.

REFERENCES

1. Wiley, Victor Lucas, Thomas. (2018). Computer Vision and Image Processing: A Paper Review. International Journal of Artificial Intelligence Research. 2. 22. 10.29099/ijair.v2i1.42.
2. Bochkovskiy, A., Wang, C. Y., & Liao, H. Y. M. (2020). Yolov4: Optimal speed and accuracy of object detection. arXiv preprint arXiv:2004.10934.
3. A. Alam and Z. A. Jaffery," A computer vision system for detection and avoidance for automotive vehicles," 2015 Annual IEEE India Conference(INDICON), New Delhi, India, 2015, pp. 1-6, doi: 10.1109/INDICON.2015.7443366.
4. Ghosh, P. K. Kundu and G. Sarkar," Computer Vision based Obstacle Identification using Real-Time Illumination Sensor Data," 2021 IEEE Second International Conference on Control, Measurement and Instrumentation (CMI), Kolkata, India, 2021, pp. 190-195, doi:10.1109/CMI50323.2021.9362734.
5. Utaminingrum, F., Fauzi, M. A., Wihandika, R. C., Adinugroho, S., Kurniawan, T. A., Syauqy, D., ... & Adikara, P. P. (2017, August). Development of computer vision based obstacle detection and human tracking on smart wheelchair for disabled patient. In 2017 5th International Symposium on Computational and Business Intelligence (ISCBI) (pp. 1-5). IEEE.
6. M. Etxeberria-Garcia, M. Labayen, M. Zamalloa and N. Arana- Arexolaleiba," Application of Computer Vision and Deep Learning in the railway domain for autonomous train stop operation," 2020 IEEE/SICE International Symposium on System Integration (SII), Honolulu, HI, USA, 2020, pp. 943-948, doi: 10.1109/SII46433.2020.9026246.
7. A. H. Alquhali, M. Roslee, M. Y. Alias and K. S. Mohamed," IOT Based Real-Time Vehicle Tracking System," 2019 IEEE Conference on Sustainable Utilization and Development in Engineering and Technologies (CSUDET), Penang, Malaysia, 2019, pp. 265-270, doi: 10.1109/CSUDET47057.2019.9214633.
8. Zhang, Qiang Yan, Fei Song, Weina Wang, Rui Li, Gen. (2023). Automatic Obstacle Detection Method for the Train Based on Deep Learning. Sustainability. 15. 1184. 10.3390/su15021184.
9. Lee, C. H., Su, Y. C., & Chen, L. G. (2012, May). An intelligent depth-based obstacle detection system for visually-impaired aid applications. In 2012 13th International Workshop on Image Analysis for Multimedia Interactive Services (pp. 1-4). IEEE.
10. Amjoud, A. B., & Amrouch, M. (2023). Object detection using deep learning, CNNs and vision transformers: a review. IEEE Access.

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