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CCTV Based Accidents Avoidance Using Image Processing

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ABSTRACT: To mitigate the rising number of suicides and accidental falls on railway and metro tracks, a proposed method employs image analysis and computer vision techniques on real-time CCTV feed to detect behaviors indicative of suicidal intentions or unintentional falling. The method evaluates individuals based on eleven parameters and immediately notifies the control room if any such behaviors are detected, reducing the need for expensive measures like increased security guards and CCTV in old stations. The system also includes a low-cost camera unit hardware for image capture/processing and communication, enabling early warnings to drivers at intersections for quick reactions to critical situations. Ethical considerations related to personal data handling and the use of automated systems are also discussed in the article.

KEYWORDS: surveillance, YOLO, COCO, Scikit, PIL, CVT(Computer vision technique)

I. INTRODUCTION

To ensure passenger safety and security at railway and metro stations in smart cities, CCTV surveillance is commonly used but manual monitoring is labor-intensive. This problem can be solved by using Image Analysis and other Computer Vision techniques on real-time CCTV feed to detect behaviors indicating suicidal intentions or accidental falling. Two frameworks that use Artificial Intelligence (AI) technologies are developed to extract useful information from large video datasets in the railway industry. In addition to mitigation measures such as fencing, video analytics tailored to rail can offer coordination with physical and management solutions to reduce risks. Although digital technology has the potential to contribute greatly, ethical concerns regarding public privacy and data handling must be considered. This survey supports the use of these technologies in rail to enhance public security, decrease railway suicides, and balance benefits and costs.

II. OBJECTIVE

Below is a list of objectives that we have determined are a requirement for our model to meet.

One of the major components of our design is the ability for the CCTV cameras to recognize any kind trespassing in railways and metro stations.

- Trespassing recognition feature

To enhance the existing platform, a new trespassing recognition feature will be added using YOLOv5 and DeepSort. YOLOv5, a family of object detection models, will be used as the detection model. It is trained on the COCO dataset. DeepSort, on the other hand, will be used for tracking the objects based on both the velocity and motion of the object, as well as the appearance of the object. This feature will utilize a metric that combines motion and appearance descriptors to accurately track and identify trespassers.

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- Eliminate trespassing on railways and eradicate suicide

The VIANA platform has successfully integrated a trespassing recognition feature using Crowd YOLOv5m as the detection model and DeepSort as the tracking model. This implementation has met several functional and non-functional requirements. The utilized models have required 92% GPU utilization, which enables the system to take necessary precautions before accidents occur.

- Suicidal Intention Detection.

CCTV captures the images and detect human behavior or any kind of suicidal intentions. The captured images are identified and classified by the YOLOv5 algorithm. The given algorithm sends alerts to the concerned authorities. Deepsort it used to track the object velocity, motion etc.

- Prevention of accidents mainly on metro stations and railways

Automated surveillance systems have the potential to replace human surveillance and address safety concerns at level crossings. Deep Learning and COCO datasets are commonly used in artificial intelligence (AI) methods for object detection. To create an effective surveillance system for level crossings, specialized frameworks need to be developed.

III.CONCEPT

The proposed system utilizes image analysis and CVT to detect suicidal intentions or accidental falling on railway and metro tracks in real-time CCTV feed. The system evaluates individuals based on the eleven parameters that are indications of such behaviors and immediately notifies the control room. The article discusses the challenges and benefits of using CCTV surveillance methods for rail networks and introduces advanced methods for object detection and behavior recognition. The concept also includes a low-cost hardware for image capture/processing and communication with vehicles to provide early warnings to drivers at intersections. The article also addresses ethical concerns regarding personal data handling and the use of automated systems. The goal is to reduce the number of fatal accidents and suicides in Indian railways and metro stations.

IV.METHODOLOGY

The system basically only requires a CCTV camera to capture images and by using image processing we are going to use the YOLOv5 and deep learning methods

- Preprocessing

Pre-processing in image analysis refers to a series of operations that are performed on raw image data before it is used for further analysis or processing. These operations are designed to remove noise, artifacts, or other unwanted features from the images, and to enhance the features of interest in order to improve the accuracy of subsequent analysis.

- Image data handling

The process involves organizing images based on the labeled emotions assigned to them. To achieve this, a Perl file was created initially sort the images into folders according their assigned emotion labels. However, due to incorrect labeling and confusion caused by the neural network algorithm, manual segregation of the images was required to improve the results. In addition, to enhance the accuracy of the results, another Perl script was employed to eliminate images with low resolution.

- Image processing for quality improvement

To improve the quality of the dataset, two techniques will be employed. The first technique is Single Image Super-Resolution (SISR), which uses Deep Learning to generate high-resolution images from low-resolution images. However, generating high-quality images from low-resolution ones is a challenging task as high-frequency content is

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often lost in low-resolution images. Therefore, the use of Deep Learning is necessary to restore the lost details and improve the resolution of the images.

- Deep learning for emotion classification or

Our machine learning approach is based on deep learning networks, specifically pre-trained neural networks that have been trained on a large dataset of over a million images. To leverage this pre-existing knowledge, we employ transfer learning techniques, utilizing a pre-trained network such as AffectNet. This dataset contains approximately 0.4 million manually labeled images of facial expressions for eight different emotions, including neutral, happy, angry, sad, fear, surprise, disgust, and contempt. Additionally, the dataset provides the intensity of valence and arousal associated with each image.

- Post-processing model evaluation

Here, we will evaluate the performance of the deep learning model on the identified classes. To assess the model's performance, we will use a commonly used visualization tool in the field of machine learning known as the confusion matrix. We will use Matlab to plot the confusion matrix for each experiment conducted.

V. HARDWARE & SOFTWARE TOOLS DESCRIPTION

- PIL- The Python Imaging Library (PIL), it is the image processing package tool for the Python programming language. However, support for PIL was discontinued in 2011, and as a result, a project named Pillow was created to replace it. Pillow is a fork of the original PIL project that includes Python 3.x support.
- SciKit- Scikit-image is a popular image processing Python package that works with NumPy arrays. It provides a number of collection of algorithms for the image processing, including image enhancement, filtering, segmentation, and feature extraction.
- ImpleCV- OpenCV is an open-source computer vision framework that provides access to several powerful computer vision libraries. It includes a vast collection of image processing algorithms and machine learning tools that can be used to develop the computer vision applications. OpenCV supports multiple programming languages, including C++, Python, and Java, and can run on various platforms such as Windows, Linux, and MacOS.
- YOLOv5- YOLOv5 is an open-source deep learning framework for object detection and classification. It is based on the YOLO (You Only Look Once) family of models and is designed to be fast and accurate. YOLOv5 is trained on the COCO (Common Objects in Context).
- ImageJ Filters- The smoothing filter is a type of image processing filter that works by taking an average of the neighboring pixels in an image. However, unlike a standard averaging filter, the smoothing filter only includes pixels that are within a certain range of the current pixel value. This range is defined by the standard deviation of the pixel values within the neighborhood, and can be adjusted by the user.
- Stand Alone System/CCTV- These HD-TVI Standalone DVR systems are a great choice for the budget-minded homeowner. These camera systems provide HD quality video up to 1080P resolution and record to an embedded style DVR, providing you with great quality recording and remote access to your cameras from an iPhone, Android or Windows PC. Another great thing about these HD-TVI systems, is that they use traditional coaxial siamese cables, which means that homeowners that already have analog cameras can simply unplug their old cameras and DVR and install these HD-TVI cameras and DVR in their place. As long as your coaxial cables are still in good condition, you will be able to start covering your home with HD quality video.

VI. RELATED WORK

The study simulates a railway level crossing on an automobile road and provides a quantitative validation of the suggested strategy. The method makes use of a single sensor, specifically a 3D-LIDAR, which is more dependable and resilient than image-based systems. The 3D-LIDAR sensor can function in low light and varied weather conditions and delivers a 3D point cloud with distance measurements of the surroundings. The LIDAR-IoT system is deployed in actual settings as part of the evaluation technique.[1]

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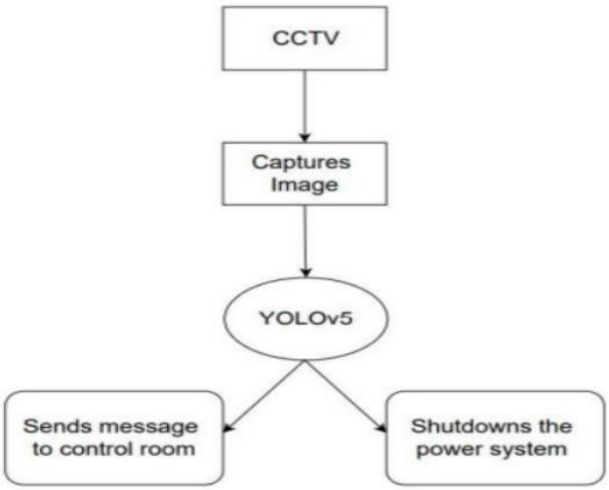
The image capture, face feature detection, head pose estimation, and gaze tracking modules make up the four primary components of the driver sleepiness detection system. The algorithm is made to recognise indications of driver fatigue, warn the driver, and notify the hardware to halt the vehicle. The device creates a warning message for the driver and tracks the frequency of eye blinking, eye closure, and distracted vision as symptoms of tiredness. Using an ultrasonic sensor to measure the space between the front and back vehicles, the system also analyses traffic outside the car. A warning to slow down the vehicle is given to the driver if the distance is too close. If the driver does not reduce the speed, auto braking system will be activated to stop the vehicle.[2]

Due to the continually shifting circumstances, which produce scenes where the backdrop is difficult to discern, illumination varies, and processing speed needs to be quick, performing image processing in these applications can be difficult. Two complimentary methods for object detection and tracking are frequently employed to overcome these issues.The first tactic entails locating the rails and bottom-up examining the vicinity of them to look for potential impediments. This technique works well to find impediments that are near to the rails and fixed items that are in front of the train.Based on the optical flow between frames, the second strategy. The programme can identify potential dangerous objects, follow their trajectories, and anticipate their courses to evaluate whether there is a course for collision by eliminating background moving elements. This approach has the benefit of providing an early warning when an object could endanger the train's safety.. [3]

In two stages, the suggested fuzzy steering controller-based pedestrian collision avoidance system (CAS) is assessed. Several avoidance manoeuvres are manually performed in the first stage to assess the accuracy of the sensors and comprehend how the drivers act. The parameters for the second step can be determined with the aid of this investigation. Field tests are done in the second stage to show how well the autonomous pedestrian collision avoidance system works. The objective is to demonstrate the viability of the suggested strategy in realistic situations..[4]

The suggested technique seeks to identify bicycle trip recordings that show riders dodging obstacles. There are two stages to the algorithm: In order to gather information about the bicyclist's gestures from the films, the system first use OpenPose. A trained SVM is employed in the second stage to find the obstacle avoidance behaviour. The system creates size-reduced films, extracts features, and detects results of the obstacle avoidance behaviour on a small computer like the Raspberry Pi. By using this method, the data size of the films is reduced, making it simpler to store and analyse the data.[5]

VII. SYSTEM ARCHITECTURE



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VII.PROPOSED SYSTEM

The Viana platform for computer vision is being used to implement YOLOv5 compound scaled object detection models for this software, along with the Deep sort framework for object tracking that considers both the object's motion and appearance. Our proposed methodology for human behavior detection involves utilizing deep learning techniques and artificial intelligence. We will employ image processing to identify people's behavior and predict outcomes, with the AffectNet database being used to classify the captured emotions. The ultimate goal of our system is to monitor the railway station environment, promptly alert authorities of any unusual occurrences, and take necessary action while minimizing disturbance to other passengers.

IX. ADVANTAGES OF PROPOSED SYSTEM

The proposed system aims to improve the accuracy of previous models by utilizing image processing techniques to determine the emotions of individuals. To achieve this, a more diversified dataset, such as the AffectNet database, is used to increase the precision of emotion detection.

X.CONCLUSION

The proposed system is still in the development stage and has not been implemented in real-life scenarios yet. Its main objective is to reduce the number of suicides that occur in railway-related areas. The system works by capturing images from CCTV cameras and analyzing them using the YOLOv5m and DeepSort models to detect human behavior and any suicidal intentions. The identified images are then classified and alerts are sent to the relevant authorities. The VIANA platform also includes a trespassing recognition feature which has met some of the functional and non-functional requirements. However, the current model requires a high GPU utilization of 92%.

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