Abnormal Behavior Detection for Road Safety

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Abstract *The increasing number of road accidents and fatalities worldwide has prompted the need for advanced safety measures and intelligent systems to monitor and mitigate risks on the road. Abnormal behavior detection plays a pivotal role in enhancing road safety by identifying and responding to potentially hazardous situations in real-time.*

This system presents an innovative approach to abnormal behavior detection for road safety, leveraging cutting-edge technologies such as computer vision, machine learning, and sensor fusion. Our system integrates data from multiple sources, including onboard cameras and vehicle telemetry, to create a comprehensive situational awareness framework. Through the application of deep learning algorithms, we analyze this multi- modal data to identify and classify abnormal behaviors exhibited by vehicles, pedestrians, and cyclists on the road.

Index Terms— *World Health Organization, Abnormal behavior detection, deep learning algorithms, computer vision, machine learning,*

I. INTRODUCTION

Road safety is a critical concern globally due to the high number of accidents, in- juries, and fatalities occurring on roadways. The World Health Organization (WHO)reports that road traffic accidents are a leading cause of death and injury, with mil- lions of lives lost and countless more individuals suffering from lifelong disabilitiesevery year. In response to this ongoing crisis, there has been a growing emphasis ondeveloping advanced technologies and intelligent systems to enhance road safety.

Abnormal behavior detection for road safety represents a pivotal area of research and development in the quest to reduce accidents and save lives. Traditionally, roadsafety measures have relied on static signage, traffic signals, and human enforcement. While these methods have been effective to some extent, they often fall short in addressing dynamic and unexpected situations that occur on the road. It capitalizes on technological advancements and data-driven approaches to address one of the most pressing public health challenges worldwide.

A combination of humanitarian, economic, technological, and regulatory factors. By harnessing the power of advanced technologies and data-driven approaches, these systems aim to make roads safer, save lives, and create more efficient and sustain- able transportation ecosystems.

To significantly reduce the number of road accidents by promptly identifying and responding to abnormal behaviors exhibited by vehicles, pedestrians, and cyclists.

To prevent injuries and fatalities resulting from road accidents.

To comply with traffic laws and regulations by providing real-time feedback and alerts for behaviors that pose a danger to themselves and others.

II. LITERATURE SURVEY

Cunsuo Pang, Shengheng Liu and YanHan [1] invented Radar detection of high-speed targets suffers from range walks during the integrationtime. Methods in current use for mitigating range walks are beset by high computational complexity therein that hinders practical real-time processing. In this context, we exploit the sparsity of the target echo in the transform domain and propose an efficient range walk mitigation algorithm based on sparse Fourier transform (SFT).Concretely, the input long echo sequence is first divided into short overlapped segments with an SFT bucket structure. Then, speed compensation is performed to theshort segments, which involves less complex multiplications. Subsequently, SFT is employed which efficiently obtains the Fourier transform of the long sequence such that the range alignment of the multi-pulse echo is accomplished.

Zhiyong Niu ,Jibin Zheng, Tao Su, Wentong Li, and Lu Zhang [2] presents a blind speed side lobe (BSSL) induced by the ambiguous velocity is a main challenge in the long-time coherent integration based high-speed target detection. In this article, considering the support area difference between the BSSL and the real target, [2] propose an improved minimized windowed Radon– Fourier transform (RFT)-based radar high-speed target detection method to suppress the BSSL and realize target detection. First, two groups of window functions are designed to force the BSSL support areas to split, and then, minimum operations are adopted to sup- press the BSSL. The effect of minimum operation on target detection is theoretically analyzed for the first time. Finally, the validity of the proposed algorithm is verifiedby the measured data. Compared with RFT and CWFM, this algorithm can suppress BSSL more significantly.

Chunlei Wang, Hongwei Liu and Bo Jiu, [3] facing high-speed targets, the traditional radar target detection framework may suf fer from performance degradation due to the signal-to-noise

ratio loss caused by Doppler mismatches, especially for phase coded waveforms. In this paper, an end-to- end sliding residual network detector (SRND), which is derived from the likelihood ratio test, is proposed to detect high-speed targets in additive white Gaussian noise environments with a single radar echo pulse. The SRND uses a residual network with an efficient depth to increasingly capture the representations of target echoes, and we partially show this process through visualization. The SRND is robust to target velocities because the employed residual network utilizes layers of convolutional filters to match with target echoes of both low-speed and high-speed targets. Besides, with a waveform adapter, the SRND is compatible with different wave- forms, that is to say, the SRND needs to be trained only once and then can cope withdifferent phase modulations of waveforms. More importantly, the SRND, which is trained with computer-generated data only, can deal with not only simulated data but also measured data. Numerical experiments are given to demonstrate the superior detection performance of the SRND over the traditional detector.

Abnormal Crowd Behavior Detection Using Motion Information Images and Convolutional Neural Networks [4] introduce a novel method for abnormal crowd event detection in surveillance videos. Particularly, this work focuses on panic and escape behavior detection that may appear because of violent events and natural disasters. First, optical flow vectors are computed to generate a motion information image (MII) for each frame, and then MIIs are used to train a convolutional neural network (CNN) for abnormalcrowd event detection. The proposed MII is a new formulation that provides a visual appearance of crowd motion. The proposed MIIs make the discrimination between normal and abnormal behaviors easier. The MII is mainly based on the optical flowmagnitude, and angle difference computed between the optical flow vectors in consecutive frames. A CNN is employed to learn normal and abnormal crowd behaviorsusing MIIs. The MII generation, and the combination with a CNN is a new approachin the context of abnormal crowd behavior detection. Experiments are performed on commonly used datasets such as UMN and PETS2009. Evaluation indicates that ourmethod achieves the best results

Daxin Tian, Chuang Zhang, Xuting Duan, and Xixian Wang [5] car accidents cause a large number of deaths and disabilities every day, a certain pro- portion of which result from untimely treatment and secondary accidents. To some extent, automatic car accident detection can shorten response time of rescue agencies and vehicles around accidents to improve rescue efficiency and traffic safety level. In this paper, we proposed an automatic car accident detection method based on cooperative Vehicle Infrastructure Systems (CVIS) and machine vision. First of all, a novel image dataset CAD-CVIS is established to improve accuracy of accident detection based on intelligent roadside devices in CVIS. Especially, CAD-CVIS is consisted of various kinds of accident types, weather conditions and accident location, which can improve self-adaptability of accident detection methods among differenttraffic situations. Secondly, we develop a deep neural network model YOLO-CA based on CAD-CVIS and deep learning algorithms to detect accident.

A Comprehensive Study on IoT Based Accident Detection Systems for Smart Vehicles [6] with population growth, the demand for vehicles has increased tremendously, which has created an alarming situation in terms of traffic hazards and road accidents. The road accidents percentage is growing exponentially and so are the fatalities caused due to accidents. However, the primary cause of the increased rate of fatalities is due to the delay in emergency services. Many lives could be saved with efficient rescue services. The delay happens due to traffic congestion or unstable communication to the medical units. The implementation of automatic road accident detection systems to provide timely aid is crucial. Many solutions have been proposed in the literature for automatic accident detection. The techniques include crash prediction using smartphones, vehicular ad-hoc networks, GPS/GSM based systems, and various machine learning techniques. With such high rates of deaths associated with road accidents, road safety is the most critical sector that demands significant exploration.

Delay-Aware Accident Detection and Response System Using FogComputing [7] globally, a significant number of deaths occur each year, caused by excessive de- lays in rescue activities. Vehicles embedded with sophisticated technologies, along with roads equipped with advanced infrastructure, can play a vital role in the timelyidentification and notification of roadside incidents. However, such infrastructure and technologically-rich vehicles are rarely available in less developed countries. Hence, in such countries, low-cost solutions are required to address the issue. Systems based on the Internet of Things (IoT) have begun to be used to detect and reportroadside incidents. The majority of the systems designed for this purpose involve theuse of the cloud to compute, manage, and store information. However, the centralization and remoteness of cloud resources can result in an increased delay that raisesserious concerns about its feasibility in emergency situations; in life-threatening situations, all delays should be minimized where feasible. To address the problemof latency, fog computing has emerged as a middleware paradigm that brings the cloud-like resources closer to end devices. In light of this, the research proposed here leverages the advantages of sophisticated features of smartphones and fog computting to propose and develop a low-cost and delay-aware accident detection and response system, which we term Emergency Response and Disaster Management System (ERDMS).

In this paper, we present a critical analysis of various existing methodologies used for predicting and preventing road accidents, highlighting their strengths, limitations and challenges that need to be addressed to ensure road safety and save valuable lives.

III. PROBLEM STATEMENT

Road safety is a critical concern in today's society, and identifying abnormal behaviors on the road is essential to

prevent accidents and ensure the well-being of all road users. This paper aims to study a computer vision system for abnormal behavior detection on the road using Convolutional Neural Networks (CNN).

It will also contribute to a more comprehensive approach to road safety that combines technology, data analysis, and driver awareness.

IV. SCOPE OF SYSTEMS

The scope of abnormal behavior detection for road safety encompasses a wide range of technologies and methodologies aimed at identifying and mitigating unusual or dangerous behaviors on the road. Accident Detection systems are used to monitor roads and intersections, identifying accidents, traffic congestion, and other incidents that could disrupt traffic flow or endanger lives.

Crowd Detection systems are used to monitor roads and intersections, identifying accidents, traffic congestion, and other incidents that could disrupt traffic flow or endanger lives.

The scope of these applications continues to expand as technology advances, making them valuable tools for ensuring safety, optimizing operations, and enhancing overall user experiences.

V.ALGORITHM

1. CNN:

The term "CNN" typically refers to Convolutional Neural Networks, which are a class of deep learning models commonly used for computer vision tasks like image classification, object detection, and image segmentation.

Gather a dataset of labeled images relevant to your task. Define the architecture of your CNN.

This involves specifying the number of layers, the types of layers (convolutional, pooling, fully connected, etc.), and their configurations (e.g., kernel size, stride, padding).

Initialize the model's weights and biases. Pass the training data through the network one batch at a time.

Continuously monitor the model's performance in production, as data distributions may change over time.

2. YOLO:

The YOLO (You Only Look Once) algorithm is an object detection algorithm that works by dividing the input image into a grid and predicting bounding boxes and class probabilities for each grid cell. It uses a single convolutional neural network (CNN) to make these predictions in one pass, making it fast and efficient. After predicting bounding boxes, YOLO uses non-max suppression to eliminate redundant boxes and outputs the final set of bounding boxes along with their corresponding class labels and confidence scores.

Here are the steps of the YOLO (You Only Look Once) algorithm in a nutshell:

1. Divide Image: Divide the input image into an $S \times S$ grid.
2. Predict Bounding Boxes: For each grid cell, predict a fixed number of bounding boxes and their corresponding confidence scores.
3. Predict Classes: For each bounding box, predict the probabilities of different classes.
4. Non-max Suppression: Eliminate redundant boxes by keeping only the boxes with high confidence scores and suppressing others that overlap significantly with them.
5.Output: Output the final set of bounding boxes along with their class labels and confidence scores as the detected objects in the image.

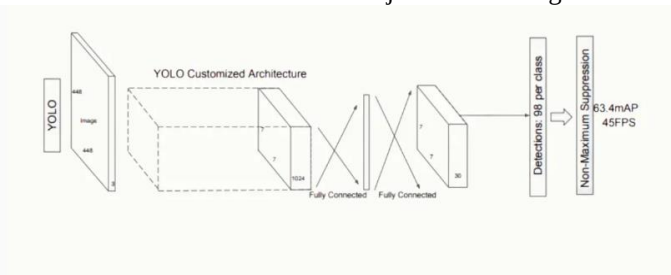


Fig. YOLO Structure

VI. TOOLS AND TECHNOLOGY USED

- Operating System Platform: Windows 10
- Coding Languages: Python
- Database Used: MySQL
- OpenCV - Python Framework
- Anaconda (v3.6) - A good package and environment manager that comes with a lot of data scientific computing tools such as Numpy, Pandas and Matplotlib.
- Processor: Intel core i3 (min)
- Speed: 2.0 GHz(min)
- RAM: 2 GB (min)
- Hard Disk: 20 GB (min)
- Camera (5mp)

VII. PROPOSED SYSTEM

The primary goal is to develop an automated and highly accurate system to reduce the manual workload of physicians and minimize the occurrence of incorrect diagnoses, particularly in cases of knee osteoarthritis. The system encompasses various components: user registration, login for registered users, a training phase utilizing 80% of the data with Convolutional Neural Network (CNN) and Support Vector Machine (SVM) algorithms, and a testing phase involving the remaining 20% of the data. During testing, users can input knee images, and the system will swiftly determine the presence of Knee Osteoarthritis. The CNN, specialized in recognizing image patterns, and the SVM, effective in categorizing data based on specific features, collaborate to enhance the accuracy and efficiency of knee osteoarthritis detection, offering a valuable diagnostic tool.

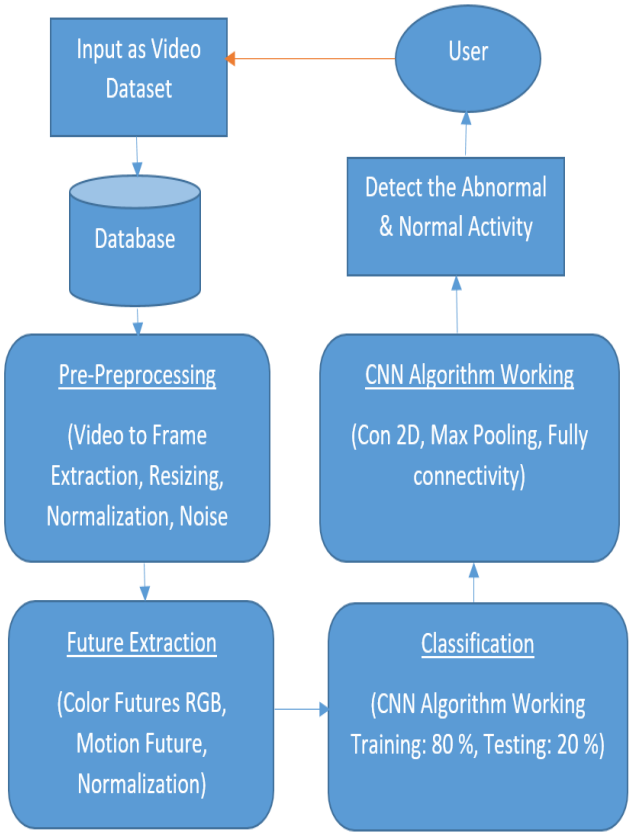
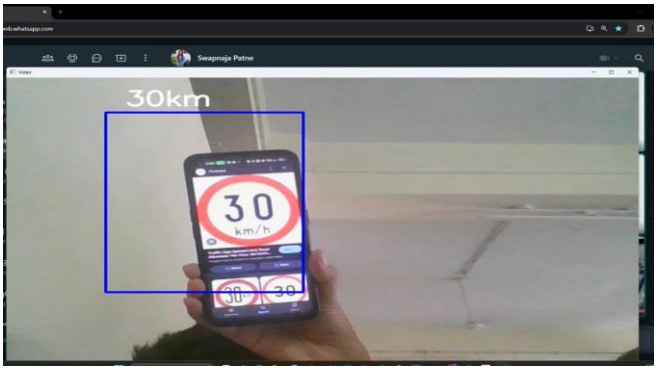


Fig.1 System Architecture

VIII. OUTCOME OF SYSTEM



IX. CONCLUSION & FUTURE WORK

In conclusion, abnormal behavior detection for road safety represents a transformative approach toaddressing the pressing issue of road accidents and fatalities. This innovative technology leverages advancements in sensor technology, machine learning, and computer vision to identify and respond to abnormal behaviors exhibited by vehicles, pedestrians, and cyclists on the road. By harnessing the power of technology and data, these systems contribute to safer and more reliable roadways, aligning with the overarching goal of creating a transportation ecosystem that prioritizes safety and sustainability. However, their successful deployment also requires a balanced approach that addresses ethical, legal, and privacy considerations while ensuring the seamless integration of these systems into existing transportation infrastructure.

The future of abnormal behavior detection for road safety lies in the integration of cutting-edge technologies, collaboration between stakeholders, and a focus on creating comprehensive, intelligent, and ethical solutions. As these technologies continue to evolve, they will play a pivotal role in making roads safer for everyone.

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