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Machine Learning Driven Accident Identification and Notification System Using Camera Inputs and YOLOv4.

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ABSTRACT—

Around the world, auto accidents continue to be a major source of fatalities and financial losses. The likelihood of saving lives can be increased and response times can be significantly shortened by promptly identifying these situations and notifying emergency personnel. With an emphasis on those that use camera-based inputs and the YOLOv4 algorithm, this study examines recent advancements in machine learning-powered accident detection and warning systems in greater detail. In order to construct these systems, we investigate a range of machine learning approaches and communication strategies. We also point out existing drawbacks and offer ideas for future developments to improve the dependability and effectiveness of these technologies.

Keywords— Accident Identification, Notification System, Machine Learning, Camera, YOLOv4, Real-time, Emergency Response.

Introduction

Every year, many people are killed and injured in traffic accidents, which remain a major global problem. The World Health Organisation states that one of the main causes of mortality for people between the ages of 5 and 29 is traffic accidents. Delays in emergency response can frequently have a significant impact on the extent of injuries and the participants' chances of survival. Because of this, it is more crucial than ever to have dependable and effective accident detection and alarm systems.

Conventional accident reporting techniques sometimes rely on the testimonies of witnesses or the victims themselves, which can be laborious and prone to mistakes. However, developments in communication networks, machine learning, and video technology are now opening the door for intelligent systems that can swiftly and automatically identify mishaps. In order to speed up reaction times and maybe save lives, these systems are made to recognise incidents as soon as they occur and notify emergency personnel right away.

In this paper, we provide an in-depth analysis of the most recent developments in accident detection and warning systems that use camera-based inputs and machine learning, particularly the YOLOv4 algorithm. We investigate the use of YOLOv4 for real-time accident detection and the transmission of alerts to emergency agencies. In order to improve the efficacy and dependability of these systems, we also assess the advantages and disadvantages of the existing approaches and suggest future lines of inquiry.

Ease of Use

The Machine Learning-Based Accidents Detection and Alert System exhibits a number of intuitive aspects that enhance its use in general:

1. **Automatic and Minimal User Input:**

- ***Users don't need to actively initiate any tasks since the system runs on real-time data from sensor (accelerometer, gyroscope, GPS).***

- ***Because accident detection and warning are entirely automated, there is less chance of human mistake and involvement during crucial situations.***

2. **. Communication and Alerts in Real Time**

- ***End users and authorities may conveniently get alerts without the need for a smartphone app or continuous tracking thanks to instant SMS notifications sent over GSM or Internet to emergency contacts.***

3. **Real-Time Feedback via LCD Display:**

- ***An onboard display with LCD technology provides constant updates on sensor data, collision incidents, and vehicle condition.***

- ***Without requiring technical expertise, this is very helpful for users to verify the system is operating as intended.***

4. **Integrated Dependability**

- ***Having an alternate source of power guarantees that the system will continue to operate in the event of a power loss, which is crucial in the event of an accident.***

- ***This feature increases user trust and dependability, which makes it easier to utilise in practical situations.***

5. **Identified Emergency Contacts**

BECAUSE EMERGENCY NUMBERS ARE PRESET, THERE IS NO NEED TO MANUALLY ENTER THEM IN AN EMERGENCY. THIS MAKES USAGE AND SETUP SIMPLER.

6. **Preserving the Specifications' Integrity**

For the Machine Learning-Based Accident Detection and Alert System to operate dependably, the standards must be upheld. To guarantee exact real-time data gathering, this starts with precise calibration of sensors like GPS modules, gyroscopes, and accelerometers.Using high-quality parts and appropriate integration strategies to endure vehicle conditions like vibrations and power fluctuations ensures hardware dependability. Real-time processing capacities are essential because they enable the system to react quickly by identifying crashes and sending out alerts as soon as possible. The timely delivery of alarm messages containing GPS data to emergency contacts is ensured via a reliable and secure communication system, such GSM or IoT.

Clear, real-time updates from the LCD display are essential for improving user engagement and system confidence. An additional degree of dependability is added by a backup power source, which keeps the system running even in the event of a power outage. All things considered, maintaining the system's efficacy, precision, and for a long time usability in innovative transport contexts requires constant testing, performance assessment, and compliance to design standards.

PROPOSED SYSTEM

By identifying accidents in real time, the suggested system uses sensor fusion and machine learning to increase road safety. It uses an accelerometer, gyroscope, and GPS module to continuously track a vehicle's position, velocity, and direction. A microcontroller with a trained machine learning model processes the data from various sensors to find anomalous patterns that point to a collision, like abrupt brakes, strong impacts, or odd tilts. When the system detects such an occurrence, it instantly uses GSM or Internet of Things (IoT) connectivity to send an SMS alert with the vehicle's exact GPS location to pre-configured emergency contacts. An LCD display improves system transparency and makes monitoring easier for users and responders by providing immediate feedback on automobile status, sensor data, and collision alerts.A supplementary power supply is included to increase system dependability and ensure that it continues to function even in the event of a power outage. This automated and intelligent system decreases the need for human interaction, speeds up emergency reaction times, and offers a scalable, affordable way to improve vehicle safety in practical settings.

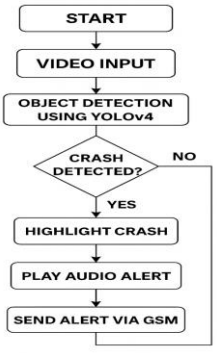


Fig 1: Flowchart

methodology

i. Dataset

A specially created collection of publicly accessible CCTV footage of actual traffic accidents—mostly from YouTube—was used to train the accident identification model. From these video sequences, over 1,000 frames of images were recovered using Python's OpenCV module. These frames, which include a variety of accident scenarios and surroundings, form the basis of training the detection algorithm.

ii. Model Training

Labelling was used to annotate visual data for the purpose of training, marking items such as cars and pedestrians. The model was then trained on the labelled dataset using YOLOv4, a fast and accurate high-performance object identification technique. Google Colaboratory, which supports GPUs and allows for faster processing, was used for training. For deployment, the finished trained model was downloaded.

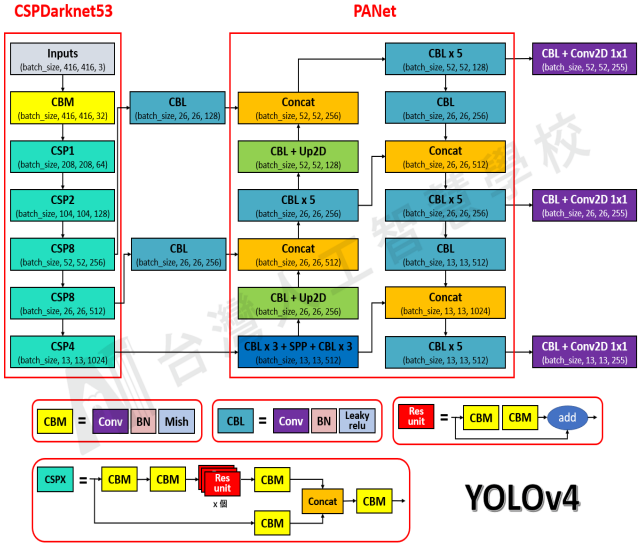


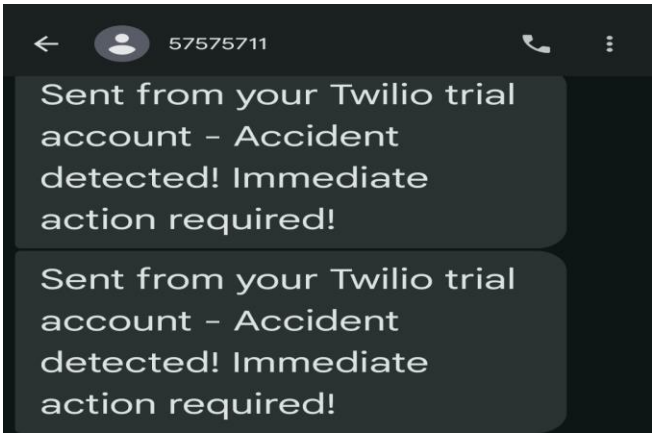
Fig 2: YOLOv4 architecture

iii. Alert System

The cloud-based messaging service Twilio is used to implement the SMS alert feature. Twilio provides more dependable message delivery, a larger network reach, and an easy-to-use API than conventional GSM-based solutions. The Twilio module is imported, and a function to deliver SMS alerts is defined, to configure the system. After that, this feature is incorporated into the accident detection model based on YOLOv4. Faster emergency response is made possible by the automated SMS that is sent to the emergency contact number that is given in the code as soon as an accident is detected. This SMS contains the location of the vehicle.

RESULT

When the ADAS system detects an accident, it immediately notifies the user by SMS. A strong and precise object detection method, the YOLOv4 model, is used to carry out the detection procedure effectively. Additionally, the messaging system operates dependably, delivering notifications quickly and consistently through the use of a cloud-based communication platform.



conclusion

This study effectively demonstrates a clever and effective method of accident detection that makes use of real-time sensor data and machine learning. In addition to correctly identifying crashes, the system makes sure that emergency services are notified right away, which can drastically cut down on response time and save lives. It is a good contender for practical use due to its affordable design, simplicity of integration, and dependable performance—even during power outages. All things considered, this solution is a significant step forward in intelligent transportation, encouraging safer roadways by utilizing AI and linked technology.

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