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Real-Time Accident Detection and Notification System for Enhanced Emergency Response and Traffic Management

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ABSTRACT: Road accidents pose a significant threat to public safety, necessitating effective emergency response systems. This paper presents a real-time accident detection and notification system with ambulance detection aimed at enhancing emergency responses and traffic management. A diverse dataset was collected and labeled for accident and ambulance detection tasks. Through the integration of convolutional neural networks (CNNs) with OpenCV, the system enables real-time analysis of video streams to detect accidents and identify ambulance vehicles. Utilizing the Twilio API, our system sends SMS notifications containing live accident locations, facilitating prompt emergency responses. Visual alerts are then provided to notify drivers and pedestrians of approaching ambulances, ensuring smoother traffic flow and expedited emergency responses. This approach prioritizes simplicity and efficiency in accident detection, ultimately aiming to enhance road safety for all individuals.

KEYWORDS: OpenCV, Twilio, Convolution Neural Network (CNNs), Python, Camera, Geolocation.

I. INTRODUCTION

Road accidents remain a pressing global concern, exacting a heavy toll in terms of human lives, injuries, and economic losses. The timely detection and effective management of these incidents are pivotal in mitigating their impact and ensuring the smooth flow of traffic. In response to this challenge, this project proposes the development of an advanced Real-time Accident Detection and Notification System with Ambulance Detection. By harnessing cutting-edge technologies such as computer vision, Internet of Things (IoT), and real-time communication, the system aims to revolutionize the way accidents are detected, assessed, and responded to.

The project entails a multifaceted approach, beginning with the collection of a diverse dataset comprising accident and non- accident images, meticulously labeled for supervised learning. Leveraging the power of convolutional neural networks (CNNs) and frameworks like TensorFlow or PyTorch, the system undergoes rigorous training to accurately differentiate between accident and non-accident scenarios. Furthermore, the integration of OpenCV facilitates real-time video stream analysis, enabling the system to detect accidents as they occur.

A distinctive feature of the proposed system is its capability to detect and respond to ambulance vehicles in addition to accidents. By repeating the data collection, labelling, and training process for ambulance detection, the system can identify ambulances in real-time video streams and provide visual alerts to nearby drivers and pedestrians. This not only expedites emergency response times but also facilitates smoother traffic flow, thereby minimizing casualties and optimizing road safety.

In essence, this project aims to leverage modern technologies to create a robust and efficient system for accident detection, notification, and response. Through seamless integration with existing infrastructure and real-time communication channels like Twilio, the system seeks to revolutionize emergency management on our roads, paving the way for safer and smarter transportation networks.

II. LITERATURE REVIEW

1. This paper discusses an AI-enabled system designed for smart cities to detect and alert about accidents using IoT (Internet of Things) devices and deep learning techniques. The system likely involves sensors placed in various locations to monitor traffic and detect accidents, with AI algorithms analyzing the data collected to identify

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potential incidents. When an accident is detected, the system sends alerts to relevant authorities or emergency services to respond promptly. The integration of IoT and deep learning enables real-time monitoring and efficient accident management in urban areas.

2. This paper presents a system that utilizes IoT technology for detecting and classifying vehicle accidents through sensor fusion. Sensor fusion involves combining data from multiple sensors to improve accuracy and reliability. In this context, the system likely incorporates various types of sensors such as accelerometers, gyroscopes, and GPS devices installed in vehicles to collect data related to motion, orientation, and location. By fusing data from these sensors, the system can accurately detect accidents and classify them based on severity or type. This technology could potentially enhance road safety by enabling rapid response to accidents and providing valuable insights for accident analysis and prevention.

3. An accident detection and alert system, like the one mentioned by Kalyani T, Monika S, and Naresh B, typically involves the use of sensors and communication technology to detect accidents and promptly notify relevant authorities or emergency services. These systems often employ various types of sensors such as accelerometers, gyroscopes, and GPS devices to monitor factors like vehicle speed, sudden changes in motion, or impact forces indicative of an accident. When an accident is detected, the system sends alerts to predefined contacts, such as emergency responders or designated contacts of the vehicle occupants, to facilitate rapid assistance and intervention. Such systems can play a crucial role in reducing response times to accidents and improving overall road safety.

4. It involves the use of technology to detect the presence and approach of ambulances on the road. This system could utilize various sensors, such as cameras, radar, or acoustic sensors, to identify the unique characteristics of ambulances, such as flashing lights, sirens, or distinctive markings. By detecting these signals, the system can accurately identify ambulances and track their movements in real-time. This information can be used to improve traffic management by giving priority to ambulances, enabling them to navigate congested areas more efficiently and ensuring timely arrival at their destinations, ultimately enhancing emergency response capabilities and potentially saving lives.

III. SYSTEM DESIGN

Live Video Stream:
This block represents the continuous flow of video footage captured from a camera source, likely mounted on a traffic monitoring system or public roadway.

OpenCV:
This block refers to the OpenCV library, a popular opensource software framework for real-time computer vision applications. It provides tools and algorithms for image processing and analysis, which are crucial for extracting frames from the live video stream.

Frames:
OpenCV extracts individual frames from the live video stream. Each frame represents a snapshot of the video at a specific point in time.

CNN Model (Accident Detection):
A Convolutional Neural Network (CNN) is a type of deep learning model specifically designed for image analysis. In this system, the CNN model is trained to identify features in the extracted video frames that are indicative of an accident, such as sudden motion blur, unusual vehicle positioning, or changes in road structure.

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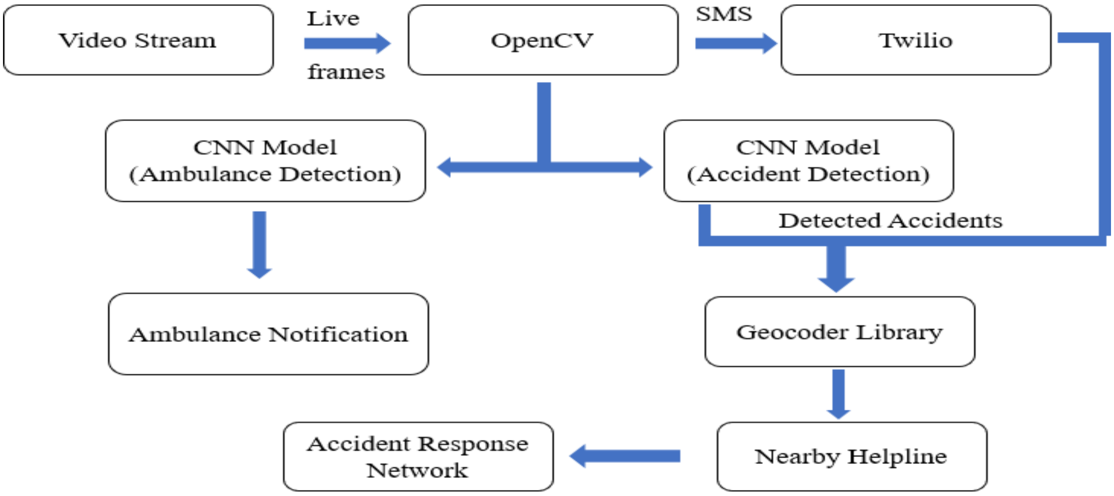

Detected Accidents:
The CNN model outputs a signal indicating whether an accident has been detected in the analyzed frame.

Geocoder Library:
This block refers to a software library that converts geographic coordinates (latitude and longitude) into a human-readable address.

Accident Response Network:
This block signifies the communication network that transmits accident data (likely including the location and time of the incident) to emergency response services.

Nearby Helpline:
This block represents the emergency services that will be notified upon accident detection. This could include ambulance services, fire departments, or law enforcement agencies.

IV. METHODOLOGY

- Data Collection : Gather a diverse dataset of accident and non-accident images from various sources, ensuring a representative sample of different accident scenarios and environmental conditions.
- Dataset Labeling : Label each image in your dataset as either an accident or a non-accident. This labeling step is crucial for supervised learning, where the algorithm learns from labeled examples.
- Monitoring and Maintenance: Monitor the performance of your deployed system and address any issues or anomalies that arise. Periodically update your models and algorithms with new data and improvements to maintain their effectiveness over time.Continuously gather feedback from users
- and stakeholders to refine and enhance the system's functionality and usability.
- Model Training:Split your labeled dataset into training, validation, and testing sets. The training set is used to train the model, the validation set helps tune hyperparameters, and the testing set evaluates the model's performance.Train your CNN model using a deep learning framework like TensorFlow or PyTorch. During training, the model learns to differentiate between accident and non-accident images by adjusting its internal parameters.
- . Evaluation and Optimization:Evaluate your trained model using metrics such as accuracy, precision, recall, and F1- score on the testing set. Optimize the model by fine-tuning hyperparameters, adjusting the architecture, or incorporating techniques like dropout or batch normalization to improve performance.

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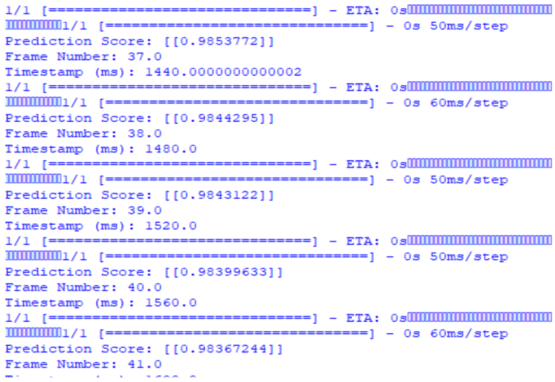
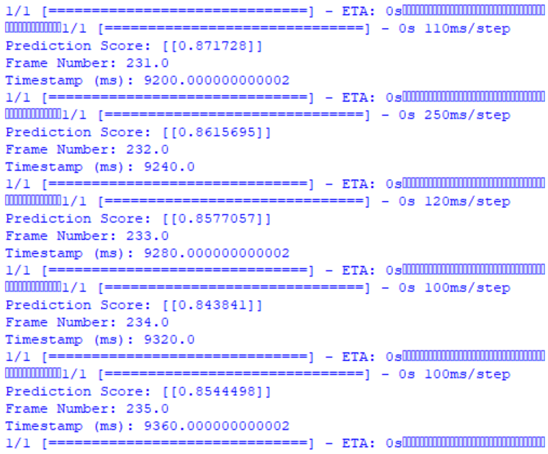
V. RESULTS



```
1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 50ms/step
Prediction Score: [[0.9853772]]
Frame Number: 37.0
Timestamp (ms): 1440.0000000000002
1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 60ms/step
Prediction Score: [[0.9844295]]
Frame Number: 38.0
Timestamp (ms): 1480.0
1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 50ms/step
Prediction Score: [[0.9843122]]
Frame Number: 39.0
Timestamp (ms): 1520.0
1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 50ms/step
Prediction Score: [[0.98399633]]
Frame Number: 40.0
Timestamp (ms): 1560.0
1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 60ms/step
Prediction Score: [[0.98367244]]
Frame Number: 41.0
```

FIG.1 : Screenshot showing accident prediction score when there is no accident



```
1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 110ms/step
Prediction Score: [[0.871728]]
Frame Number: 231.0
Timestamp (ms): 9200.000000000002
1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 250ms/step
Prediction Score: [[0.8615695]]
Frame Number: 232.0
Timestamp (ms): 9240.0
1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 120ms/step
Prediction Score: [[0.8577057]]
Frame Number: 233.0
Timestamp (ms): 9280.000000000002
1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 100ms/step
Prediction Score: [[0.843841]]
Frame Number: 234.0
Timestamp (ms): 9320.0
1/1 [==============================] - ETA: 0s
1/1 [==============================] - 0s 100ms/step
Prediction Score: [[0.8544498]]
Frame Number: 235.0
Timestamp (ms): 9360.000000000002
1/1 [==============================] - ETA: 0s
```

FIG.2 : Screenshot showing accident prediction score when there is an accident

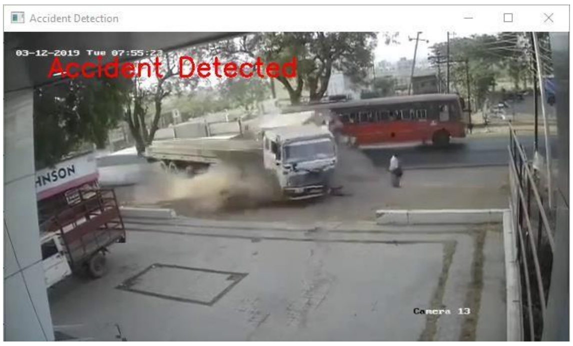


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FIG.3 & 4:Accident detection using openCV and CNN model

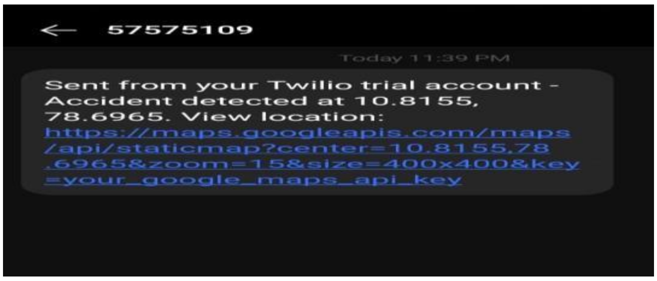
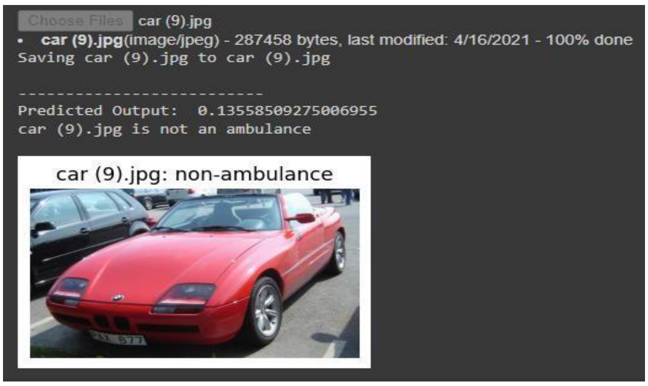


FIG.5 : Notification to the recipient using TWILIO



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VI. CONCLUSION

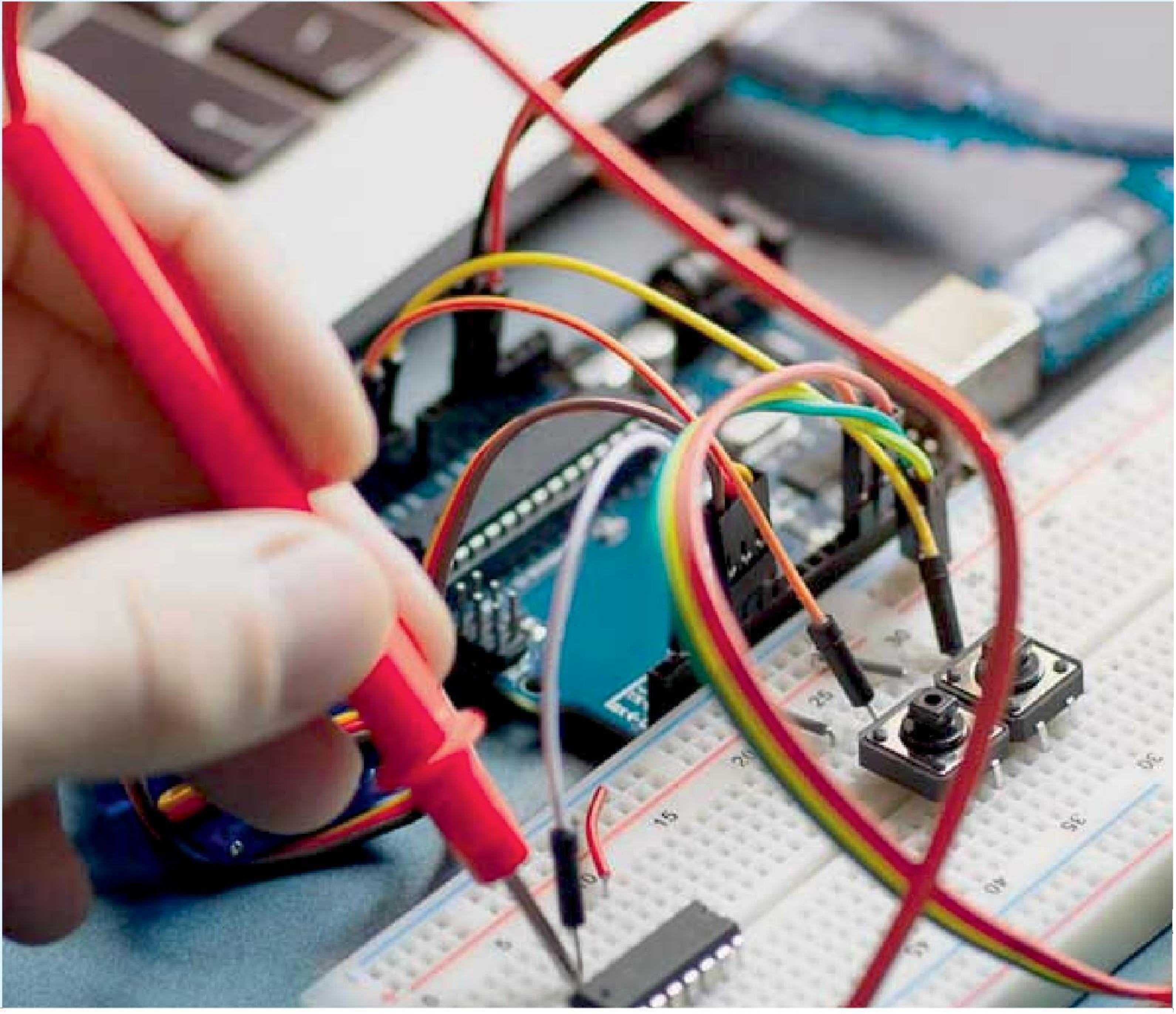
In conclusion, the development of an accident detection and notification system represents a significant advancement in road safety technology. By harnessing the power of computer vision and real-time communication, the system offers a proactive approach to accident management and emergency response. Through the integration of cameras, sensors, and machine learning algorithms, accidents can be detected swiftly and accurately, enabling timely notification of emergency services and nearby responders. Additionally, the utilization of geolocation services ensures precise accident location information, further enhancing the efficiency of emergency response efforts. Overall, the implementation of this system has the potential to save lives, reduce injuries, and minimize traffic disruptions, making significant strides towards creating safer and smarter transportation networks for communities worldwide. Continued research and development in this area hold promise for further improvements in road safety and emergency management practices.

VII. FUTURE SCOPE

- The future development of the real-time accident detection and notification system with ambulance detection holds promising avenues for further enhancement and refinement. Firstly, advancing the accuracy of accident and ambulance detection algorithms can be pursued by exploring more sophisticated deep learning architectures, such as recurrent neural networks (RNNs) or transformers, alongside ensemble models and transfer learning techniques.
- Additionally, integrating additional sensors like LiDAR or radar and leveraging IoT devices for real-time data collection can enrich the system's understanding of road conditions. Furthermore, integration with advanced traffic management systems and GIS mapping services can optimize traffic flow and provide valuable contextual information for emergency response planning. Expanding notification capabilities beyond SMS to include mobile applications and social media platforms, along with collaboration with emergency services and healthcare providers, will ensure broader dissemination of alerts and seamless coordination during emergencies.
- Finally, continuous user feedback and iterative refinement will be instrumental in adapting the system to evolving traffic patterns and emerging challenges, thus ensuring its effectiveness and relevance in enhancing road safety and emergency response efforts.

REFERENCES

1. "AI Enabled Accident Detection and Alert System Using IoT and Deep Learning for Smart Cities "by Nikhlesh Pathik ,Rajeev Kumar Gupta , Yatendra Sahu ,Ashutosh Sharma ,Mehedi Masud and Mohammed Baz
2. "Accident detection and alert system" by By Prof. M. K. Pawar, Suhas L. Gadhave, Vyankatesh K. GaikwadSagar D. Ghadage, Dipak V. Vibhute "Ambulance Detection System" by Sara B, Noureddine A ,Hajar B 10.1007/978-3-030-33103-0_3
3. Suraj Pratap Shubham; Madan Kumar; Rajkishor; Sarika Jain A Survey on Real-Time Accident Detection and Notification Systems 26 May 2021 10.1109/ICICCS51141.2021.9432159
4. Wan-Jung Chang; Liang-Bi Chen; Ke-Yu Su Deep Learning-Based Real-Time Accident Detection System Using Dashboard Camera Images 09 October 2019 10.1109/ACCESS.2019.2946468
5. [3] Harit Sharma; Ravi Kanth Reddy; Archana Karthik Smartphone-Based Real-Time Accident Detection and Notification System Using Accelerometer and GPS Sensors 29 December 2016 10.1109/ICCVE.2016.7
6. Xiangmo Zhao; Pengpeng Sun; Zhigang Xu Fusion of Vision and LiDAR Data for Real-Time Accident Detection in Autonomous Vehicles 13 January 2020 10.1109/JSEN.2020.2966034
7. Sreenithy Chandran; Sneha Chandrasekar; N Edna Elizabeth Real-Time Accident Detection and Notification System Using Internet of Things (IoT) Sensors 02 February 2017 10.1109/INDICON.2016.7839052
8. Wan-Jung Chang; Liang-Bi Chen; Ke-Yu Su Machine Learning-Based Real-Time Accident Detection Using Vehicle Telematics Data 09 October 2019 10.1109/ACCESS.2019.2946468
9. Christos Kyrkou; George Plastiras; Theocharis Theocharides; Stylianos I. Venieris; Christos-Savvas Bouganis Real-Time Accident Detection Using Unmanned Aerial Vehicles (UAVs) and Image Processing Techniques 23 April 2018 10.23919/DATE.2018.8342149
10. G. Suriya Praba Devi; J. C. Miraclin Joyce Pamila Real-Time Accident Detection and No tification System Using Blockchain Technology 06 June 2019 10.1109/ICACCS.2019.8728507
11. Lukman Adewale Ajao; Blessing Olatunde Abisoye; Ibrahim Zakariyawu Jibril; Udeme Monday Jonah; Jonathan Gana Kolo Real-Time Accident Detection and Notification System Using Roadside Sensors and Wireless Networks 12 October 2020 10.1109/PowerAfrica49420.2020.9219812
12. Wan-Jung Chang; Liang-Bi Chen; Ke-Yu Su Real-Time Accident Detection Using In-Vehicle Camera and Artificial Intelligence Techniques 09 October 2019 10.1109/ACCESS.2019.2946468



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