Auto Rescue: Instant Accident Detection and Emergency Response

Mr. Indrakumar Naragude[1], Mr. Parth Musne[2], Mr. Om Kandpal[3], Mr. Lokesh Chaudhari[4], Miss. Nidhi Karkera[5]

[1,2,3,4,5]Department of Information Technology (IT), Vishwakarma Institute of Technology, Pune, 411037, Maharashtra, India

Abstract:
Within the domain of transportation safety, the fusion of Internet of Things (IoT) and Machine Learning presents a promising approach for monitoring vehicles across various terrains, spanning from remote rural areas to bustling highways. The escalating risks associated with accidents, driven by factors such as speed and occasional human error, underscore the pressing necessity for real-time accident detection systems accompanied by swift emergency responses. This abstract delves into the amalgamation of IoT and Machine Learning as a crucial stride toward mitigating fatalities and injuries on roadways, stressing the importance of timely and effective accident detection and emergency interventions.

Keywords: Machine learning, Convolutional Neural Networks (CNN), Keras, email communication

1. INTRODUCTION

Rural road accidents often paint a grim picture: delayed help, limited resources, and potentially fatal consequences. This research introduces "Auto Rescue," a beacon of hope for these underserved areas. It utilizes the power of image recognition to instantly detect accidents and trigger automated emergency responses, saving precious minutes when they matter most.

Imagine traversing a quiet rural road when disaster strikes. Auto Rescue, embedded within vehicles, analyzes the visual scene through its trained CNN classifier. From crumpled metal to shattered glass, the system identifies telltale signs of an accident with impressive accuracy. If confirmed, it instantly extracts the location using GPS data and activates its pre-programmed response. Nearby hospitals receive email alerts, emergency beacons illuminate the scene, or first responders are directly contacted, depending on the local infrastructure.

This project transcends mere accident detection. It represents a lifeline for those caught in remote emergencies. Future sections will delve into the technical intricacies of the CNN classifier, evaluate its performance through rigorous testing, and explore potential ethical considerations. Ultimately, Auto Rescue aspires to bridge the distance between rural accidents and timely help, transforming the landscape of emergency response in forgotten corners of the world.

Furthermore, by leveraging advancements in machine learning and connectivity, Auto Rescue aims to revolutionize emergency response protocols, ensuring swift and effective assistance even in the most challenging environments.

2. LITERATURE REVIEW

This paper "Deep Learning for Real-Time Collision Detection and Avoidance" is all about how to maintain autonomous vehicles safety via advanced collision detection and avoidance systems. This paper suggests a real-time 3D collision detection and avoidance algorithm using deep learning, particularly Convolutional Neural Networks (CNNs).[1]

The review of literature examines existing researches in neural networks, which underline the importance of CNNs over traditional methods like Multilayer Perceptron (MLP). CNNs are given attention particularly for their efficiency to deal with image data that is essential for real time collision detection in the case of autonomous vehicle systems.

The review looks into basics of neural networks illustrating its biological inspiration as well as application in various domains like image processing and pattern recognition. In particular the unique architecture and convolutional layers make CNN effective in image recognition tasks.

Also, the authors outline steps that are involved in this proposed algorithm including an image capture, object detection, speed calculation, and collision prediction. It highlights accurate collision detection as a crucial factor in any autonomous vehicular system given the high stakes that are involved with regards to passenger safety.

On the whole, this literature review gives a brief picture about the research landscape of deep learning approaches to real-time collision detection and avoidance. It also paves way for the algorithm that is proposed in this paper to be implemented and evaluated.[2]

"Highway Accident Detection and Notification using Machine Learning"

The work highlights the important issue of Indian road crashes and points out the need for an immediate action to reduce the number of deaths that occur. When some existing systems are focused on accident detection using VANETs, dashboard cameras, etc.

Introduced system applies new approach based on image processing and machine learning. It is possible to track mistakes thanks to analysis of CCTV footage by means of machine-learning algorithms which has a result in 93% accuracy rate.

The framework contains data loading, training and validation modules running with CNN's convolutional neural networks for picture classification. This system continually aims at improving its accident identification capabilities through feedback loops and iteration cycles with a view to making it more efficient and accurate thereby leading to reduction in road traffic accidents rates.

"Accident Detection and Alerting System using Deep Learning Techniques"

The paper addresses the issue of increased emergency response times when there are road accidents, aiming to reduce fatalities through an Accident Detecting and Alerting System that uses deep learning techniques.

By combining modern object detection algorithms such as YOLO with Convolutional Neural Networks (CNNs), the system can autonomously detect accidents in live CCTV feeds, thus reducing reaction time and raising survival rates. Deep learning methods are superior to traditional ones that require manual feature extraction since they automatically extract features from input data making them more efficient and accurate.

The architecture of the proposed system involves input frames processing, accident detection and notification systems that would instantly inform emergency services upon crash detection Future enhancements may include integrating location tracking, vehicle identification, and crime detection which will make it possible for the system to be used in traffic management and autonomous driving scenarios.[3]

“Highway crash detection and risk estimation using deeplearning”

The present paper investigates the application of deep learning models in crash detection and prediction to minimize the adverse effects of crashes on traffic flow on roads. The study is looking at whether real-time traffic datacan be used for detecting crashes and for risk prediction.

Through analysing highly detailed traffic data collected from roadside sensors, the paper develops feature sets for deep learning models and compares them with shallow models. Results obtained from the experiments indicate that deep models seem to outperform shallow ones in crash detection while being about as good in terms of crash prediction.

This work highlights accurate and timely detection or prediction as crucial to reducing road accidents and it suggests that there is a possibility of incorporating deep learning algorithms into modernized traffic incident management systems. Nevertheless, there are still certain scientific issues accuracy of data, complexity of the model and generalization, which should be resolved before its broad application further studies.[4]

“Accident Detection, Severity Prediction, Identification of Accident Prone Areas in India and Feasibility Study using Improved Image Segmentation,Machine Learning and Sensors”

This paper presents a comprehensive solution for detection of accidents, prediction of severity in accidents and identification of accident-prone areas in India with the help of enhanced image segmentation, machine learning and sensors.

The literature review identifies various existing methods that include heartbeat based alert systems as well as clustering algorithms noting their limitations. Proposed methodology isdivided into three phases, which are, identification of accident-prone areas, classification of car accidents using image segmentation and designing a mitigation alert system. Linear regression accurately predicts potential accidents while masked recurrent neural networks improve image segmentation. For validation purposes piezoelectric shock sensors also included in the system and Random Forest Classifier for severity prediction has achieved up to 95% accuracy in identifying vulnerable regions and 92% accuracy in accident severity classification.

To make the process more effective future enhancements may involve joining data collection systems with hospitals and police stations for efficient accident response as well as development of tracking systems to see to it that there is realtime monitoring over high risk zones.

These are some interesting and valuable of many papers we have researched for our study which helped us to understandthe current scenario and market condition and has helped us to develop our own model in time.

3. Methodology/Experimental

Data Collection:

For data collection, a diverse dataset of images encompassing both car accident scenes and non-accident scenes is gathered. This dataset is meticulously curated to ensure a balanced representation of various accident scenarios and environmental conditions. To achieve this, sources such as public accident databases, social media platforms, and onlinerepositories may be utilized. Each image is labeled with its corresponding classification as either "car accident" or "non- accident," facilitating supervised learning during model training.

Model Training:
Convolutional Neural Networks (CNNs) are employed for image classification tasks due to their inherent ability to effectively process and analyze visual data. CNNs consist of multiple layers, including convolutional layers for feature extraction and pooling layers for dimensionality reduction. The collected dataset is then used to train the CNN model, wherein images are fed into the network, and the model learns to differentiate between car accident and non-accident scenarios based on the provided labels. Techniques such as data augmentation may be employed to increase the robustness of the model by introducing variations in the training data.

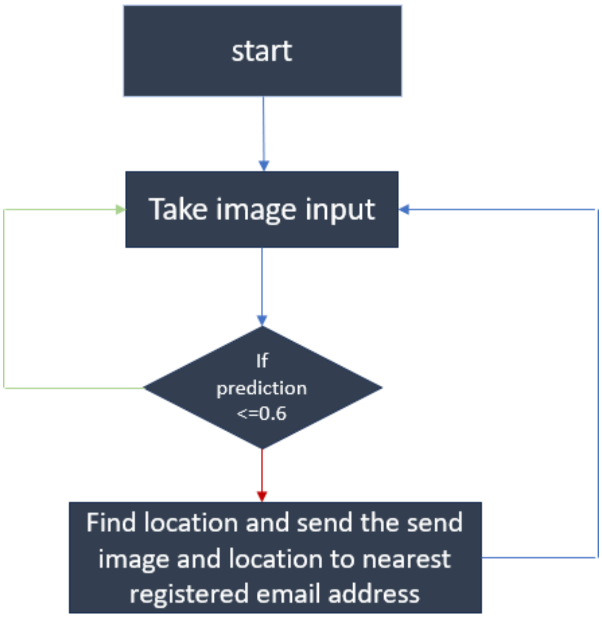
Model Testing:
After training, the Convolutional Neural Network (CNN) undergoes testing using a separate set of unseen images. These images encompass various accident and non- accident scenarios, ensuring comprehensive evaluation. The CNN processes each test image, extracting features and making predictions. Performance metrics such as accuracy, precision, recall, and F1-score are calculated by comparing the model's predictions with ground truth labels. Testing reveals the model's ability to accurately classify accidents and its generalization to real-world scenarios, guiding further refinement for optimal performance in accident detection applications.

Geolocation Integration:
Geolocation functionality is integrated into the system to retrieve the precise coordinates (latitude and longitude) of the accident scene based on the user's IP address. This is typically achieved using geocoding services or libraries such as Geocoder. By obtaining the geographical location of the accident, the system can accurately identify the nearest registered users who may be potentially affected or involved. Geolocation data plays a crucial role in enhancing the efficiency of accident notification by ensuring that relevant stakeholders are promptly informed.

Email Notification:
Upon detecting a car accident in an image, the system retrieves the contact information of the nearest registered user from a database. This database may contain user profiles with email addresses, geographical coordinates, and other relevant details. An email notification is then composed, containing comprehensive details of the accident, including the precise location coordinates and an attached image depicting the accident scene. Technologies such as the Simple Mail Transfer Protocol (SMTP) are utilized to establish a connection with the email server and send the notification seamlessly. Encryption mechanisms such as Transport Layer Security (TLS) may also be employed to ensure the security and integrity of email communication.

Overall, the integration of these techniques and technologies enables the development of an automated system capable of accurately detecting car accidents in real-time, retrieving pertinent geolocation information, and promptly notifying relevant stakeholders via email communication. This holistic approach enhances the effectiveness of accident response mechanisms and contributes to improving public safety on roadways.

THE WORKING OF THE PROJECT



4. FUTURE SCOPE

As future scope, we can focus on enhancing the accuracy of accident detection by refining the neural network architecture and augmenting training data. Additionally, we can integrate advanced geolocation algorithms for more precise accident location information, expand notification mechanisms to include multimedia channels and automated emergency service alerts, leverage contextual information extraction for a deeper understanding of accident scenarios, and bolster user engagement through crowdsourced data collection and feedback loops. Addressing privacy concerns with robust encryption and compliance measures is also essential.

5. CONCLUSION

Our methodology paper outlines the key steps involved in developing an automated system for car accident detection and notification. By leveraging machine learning, geolocation, and email communication, our proposed system aims to enhance the efficiency and effectiveness of accident response mechanisms. Currently the model is at the accuracy of 80-90%. Future research directions include refining the model's accuracy, optimizing geolocation algorithms, and exploring additional communication channels for accident notification along with a proper web interface to interact with the system.

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