Accident Detection and Alert System Using Deep Learning

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Abstract: - Using the YOLO algorithm in the accident detection and reporting system is a creative way to improve road safety. The YOLO (You Only Look Once) approach is an advanced object recognition system that can recognise and locate items in real-time video feeds. The technology uses the YOLO algorithm to identify accidents and alert emergency services, reducing response times and increasing the chance of lifesaving. Object detection and an alarm system are the two key parts of the suggested system. The YOLO method is used by the object detection component to find accidents in live video broadcasts. To correctly recognise accidents, the system is taught using a module of accident photographs. The alert system is turned on when an accident is found. The alert system notifies the emergency services of the accident's location and a brief summary of what happened. A wireless communication network is used to relay this information to the emergency services, speeding up reaction times and raising the possibility of lifesaving. The system has undergone testing on an accident module and photos, and the results are encouraging. The YOLO algorithm was shown to have an accuracy of about 94 in detecting accidents, and the alarm system's response time was under a few seconds. To increase traffic safety and lower the number of accidents, the system can be installed at busy intersections, highways, and other high-risk areas. A possible strategy to increase traffic safety is to implement crash detection and warning systems utilizing deep learning's YOLO technique. In real-time video streams, the system can precisely identify accidents and notify emergency services, speeding up response times and improving the likelihood of lifesaving.

Key Words: - ***Vehicle detection, Deep Learning, and Convolutional Neural Network, Video Surveillance.***

I. INTRODUCTION

According to statistics, more than 1.25 million individuals pass away on the roads each year, making them a very serious and urgent public health hazard. The severity of an accident can increases with any delay between accident detection and emergency intervention. Thanks to advancements in the fields of artificial intelligence, machine learning, and deep learning, we can make our technology wiser and smarter.

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The implementation of a statistical deep learning system to detect collisions and accidents in real-time video using convolution neural networks is the driving force behind this paper.

Our solution is based on computer vision technology, various methodologies, and algorithms for object detection using neural networks and deep learning. Our method will detect, categorize, track, and compute moving object velocity and direction using convolution neural network on still photos, recorded movies, and real-time live videos.

This project will use the yolo method to locate objects in an image or a live broadcast. Using a neural network on an image with 24 convolutional layers and 2 fully connected layers, the Yolo technique produces the desired results. Yolo's operation is fairly straightforward because it is built on regression. While Yolo predicts the class and bounding boxes for the entire image in a single run of the algorithm, CNN chooses the most

interesting portions of an image. A practical way to increase traffic safety and lessen the likelihood of accidents is the YOLO algorithm from deep learning. Overall, the YOLO algorithm can provide speedy and precise accident detection and alert systems.

1.1 Accident detection

Accident detection is the process of identifying and alerting emergency services or relevant parties in the event of an accident. This can involve the use of various technologies, such as cameras, and GPS systems to detect and analyze data and patterns in order to determine if an accident has occurred. Accident detection systems are commonly used in vehicles, where cameras can be used to monitor the surroundings and detect potential collisions.

1.2 Convolutional Neural Network

CNNs are deep learning models that can automatically extract relevant features from images or videos. They use a series of convolutional layers to detect local patterns and relationships in the input data, followed by pooling layers that reduce the dimensionality of the data, and fully connected layers that generate predictions based on the learned features. In the context of accident detection, cnns can be trained on large datasets of images or videos to learn the characteristics of different types of accidents, such as collision, fire, or smoke. Once trained, the CNN model can be applied to real-time video streams from CCTV cameras, drones, or other sensors to detect accidents and alert emergency services. Convolutional Neural Network can detect and classify different types of accidents with high accuracy, even in complex and dynamic environments. They have been applied to various accident detection tasks, such as traffic accident detection. CNN-based accident detection systems can significantly reduce the response time of emergency services, potentially saving lives and mitigating the impact of accidents.

II. LITERATURE SURVEY

Automated AI Based Road Traffic Accident Alert System: YOLO Algorithm In this study, the proposed accident detection system can be trained by using regression-based algorithm called YOLO (you only look once) algorithm on the sample vehicle datasets and the vehicle detection process has been successfully performed by the trained model vehicle detector being tested on the test data set with the live video feeds from the webcam. The proposed system is faster than other object detection methods and predicts the object better other object detection algorithm.

W. B. S. S. K. Athapaththu's "Real-Time Vehicle Accident Detection and Notification System Using Yolo Object Detection Algorithm" Using the YOLO object identification technique, the authors of this research suggested a real-time accident detection and reporting system. Using the dashboard camera, the technology is intended to identify highway incidents and immediately notify the appropriate authorities.

The study authored by N.N. Nwuluet (2021) titled "Utilizing YOLOv3 Object Detection Algorithm for Vehicle Accident Detection and Reporting System" recommends the implementation of the YOLOv3 object identification algorithm to identify and report car accidents. The system employs CCTV cameras to detect highway accidents and promptly notify emergency services.

The authors JAE GYEONG CHOI, J.G. KONG, and C.W. KIM suggested a technique that uses collective deep learning to identify accidents from the dashboard camera. To collect video and audio data from the camera, this method employs CNN and gated recurrent unit (GRU) to recognize and categorize the accident. One major limitation of this system is the potential damage to the dashboard camera in an accident. Furthermore, the absence of an IoT module and exclusive reliance on the camera in this approach may lead to a higher number of false positives.

In the study conducted by HAWZHIN HOZHABR POUR ET AL., an automated technique for detecting car accidents is proposed, which integrates CNN and support vector machines (SVM) to recognize the accident. This study employs various methodologies for selecting the most significant features from the available feature set. However, the authors' assertion of achieving the maximum accuracy of 85% during the testing phase may not be viable in real-world scenarios. Furthermore, the paper provides an extensive discussion of the IoT module.

The paper titled "An AI-Based System for Real-Time Detection and Reporting of Vehicle Accidents Using YOLOv2 Algorithm" by M. F. Qureshi et al. (2020) proposes the utilization of the YOLOv2 algorithm for instant detection and reporting of car accidents. The authors suggest that the system can be deployed with CCTV cameras to identify accidents on highways and alert emergency services.

Car crash detection using video data Various machine learning techniques have been widely used to detect car crashes based on different kinds of video data. Ki (2007) proposes a vision-based traffic accident detection system using charge coupled device (CCD) cameras in order to detect, record, and report traffic accidents automatically.

Vishnu and Rajalakshmi (2016) exploit linear discriminant analysis (LDA) and SVM for monitoring traffic using live video files from surveillance cameras. Ravindran et al. (2016) pro pose a novel supervised learning model based on machine vision tech niques and five SVMs trained with histogram of oriented gradients (HOG) and gray-level co-occurrence matrix (GLCM) features, which successfully detect road accidents from static images. Arceda and Riv eros (2018) propose a car crash detection system that combines a violent flow (ViF) descriptor and SVMs using closed-circuit television (CCTV) video data, which are detected through CNN. State-of-the-art deep learning techniques have been recently applied to car crash detection using video data. Chan et al. (2017) offers a dynamic-spatial-attention (DSA) recurrent neural network (RNN) model to predict car accidents from dashboard cameras. Their model is trained to distribute soft-attention to object candidates gathering subtle cues dynamically as well as modeling the temporal dependencies of all cues to robustly predict accidents. Naidenov & Sysoev (2019) develop a car accident detecting system based on CNN using video capture recordings. Yao et al. (2019) present an unsupervised deep learning framework for traffic accident detection using dashboard cameras. In particular, their approach can detect traffic accidents by predicting traffic participant trajectories as well as their future locations.

III. SYSTEM ARCHITECTURE

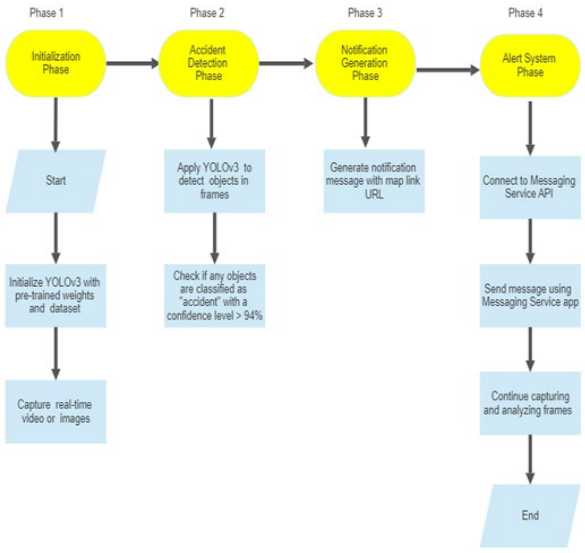

Fig.1. System Architecture

Phase 1: Initialization Phase

In this phase, the system starts by initializing the YOLOv3 algorithm with pre-trained weights and a dataset specifically designed for accident detection. It then captures real-time video or images, which will serve as input for the detection process.

Phase 2: Accident Detection Phase

Once the initialization phase is complete, the system applies the YOLOv3 algorithm to detect objects in the captured frames. It analyzes each frame to identify objects that could potentially indicate an accident. The system checks if any objects are classified as an "accident" with a confidence level greater than 94%.

Phase 3: Notification Generation Phase

If an accident is detected in phase 2, the system proceeds to this phase. Here, the system generates a notification message that includes relevant accident details. Additionally, a map link URL is included in the notification message to provide the exact location of the accident.

Phase 4: Alert System Phase

In this final phase, the system establishes a connection with the Telegram Messaging Service API. It utilizes this connection to send the generated notification message, including accident details and the map link URL, to the desired recipient(s) via the Messaging Service. After sending the notification, the system continues to capture and analyze frames, repeating the detection process until the program ends.

Detecting accidents with a high level of accuracy and promptly notifying relevant individuals through the Messaging Services.

3.1 System Algorithm and Implementation

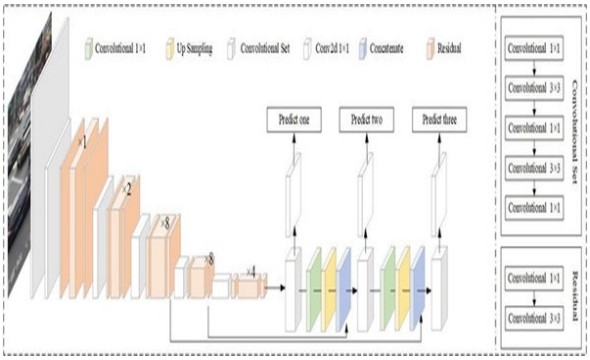

Fig.2. System Algorithm YOLO V3

Joseph and his team have proposed YOLOv3, an object detector that treats detection as a regression task, resulting in faster detection times and the ability to handle input images of various sizes. The YOLOv3 employs Darknet-53 to extract features,

which is more powerful than Darknet-19 or ResNet 101/152. Multi-scale prediction allows YOLOv3 to work on feature maps of various scales, resulting in more accurate target detection. The YOLOv3 testing procedure involves the following steps:

- Resize the input image to the required dimensions and split it into three-scale grids of 13x13, 26x26, and 52x52. If an object's center falls within a grid unit, it is predicted by the grid unit.
- Bounding box priors are established for each grid unit using k-means clustering. Each grid unit contains three clusters, resulting in nine clusters per unit across three scales.
- Submit the image to the network for feature extraction, and the model creates a small-scale feature map of size 13x13.
- Connect the 13x13 small-scale feature map to the 26x26 feature map and pass it through a convolutional set and two times up sampling to output the prediction result.
- Connect the 26x26 feature map generated in step 4 to the 52x52 feature map and put it through two rounds of up sampling and convolution to produce the prediction result.
- Integrate the characteristics of three-scale predictive outputs and filter out anchors with poor scores using a likelihood score as a cutoff. Then, use Non-Maximum Suppression (NMS) post-processing to generate more accurate boxes.

YOLOv3 can perform real-time detection on a high-speed machine using the GPU's potent computing capacity. However, real-time applications may not be practical for embedded devices, as they perform worse than high-speed computers.

3.2 Accident Detection Using Deep Learning Techniques

The deep learning model is trained to recognize data on traffic collisions using a well-known open deep learning framework. The results of the deep learning experiment showed that it is possible to detect collisions with an accuracy of more than 94% and send an alert system notification with real-time location.

To identify accident vehicle the photos are processed using a number of feature extraction techniques, then segmented and compared using a CNN classifier. The outcomes are utilized to identify and categorize accidents, as well as to pro-actively notify police station and nearby hospitals. To increase the level of prediction accuracy, preprocessing and feature extraction of both the input image and the dataset image are carried out.

The hierarchical feature extraction convolutional neural network technique utilized in this suggested method maps pixel values and assesses them on an image from a trained dataset. Since the image classification technique is being used, the compared photos are categorized as accident or not-accident images. One of the most popular libraries for computer vision applications is OpenCV, where the System is evaluated.

An OpenCV API called OpenCV-Python is the fastest and most effective option for implementing the idea of image processing for accident detection. This study describes the detection of collisions to forecast both normal and damaged or crashing automobiles. More samples need to be evaluated in order to perform research on categorizing various accidents. Photos of vehicles and photos allocated to a deep learning model for detection and classification using the suggested methodology are recorded in the images. The suggested approach has excellent results and is computationally strong and extremely effective. Additionally, it shows how effective the suggested strategy for detecting accidents is. The proposed technology also has the benefit of being able to identify car accidents at an early stage.

3.3 Dataflow Diagram

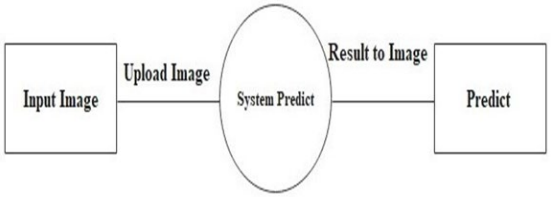

Fig.3. DFD LEVEL 0

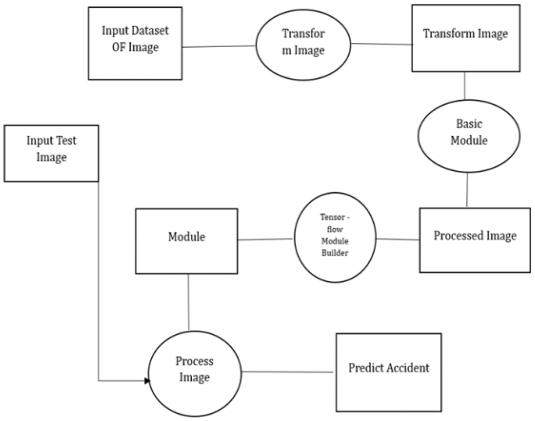

Fig.4. DFD LEVEL1

IV. CONCLUSION

As a conclusion, we suggest an accident detection alert system in this study that analyses real-time video data to find accidents on the road using deep learning algorithms. We can obtain high accuracy in classifying various accident types, such as vehicle crashes and truck crashes, by utilising the strength of feature compounding and deep learning. Our model can evaluate video from various viewpoints and angles, making it a trustworthy tool for real-time traffic surveillance and accident detection. We can also predict the severity of accidents using deep learning algorithms, and we can alert emergency services early so they can react swiftly and effectively.High-end systems and software can be used to considerably improve the system's accuracy, making it an even more effective tool for accident detection and prevention. Our non-intrusive accident detection alarm system can be utilised to speed up the response time of emergency personnel at the scene of an accident, potentially saving lives. We intend to continue this work in the future to standardise our approach for accident detection and prevention so that we can make the roads safer and have fewer accidents. Overall, our accident detection warning system has the power to completely change the way we use deep learning algorithms to monitor traffic and avoid accidents.

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