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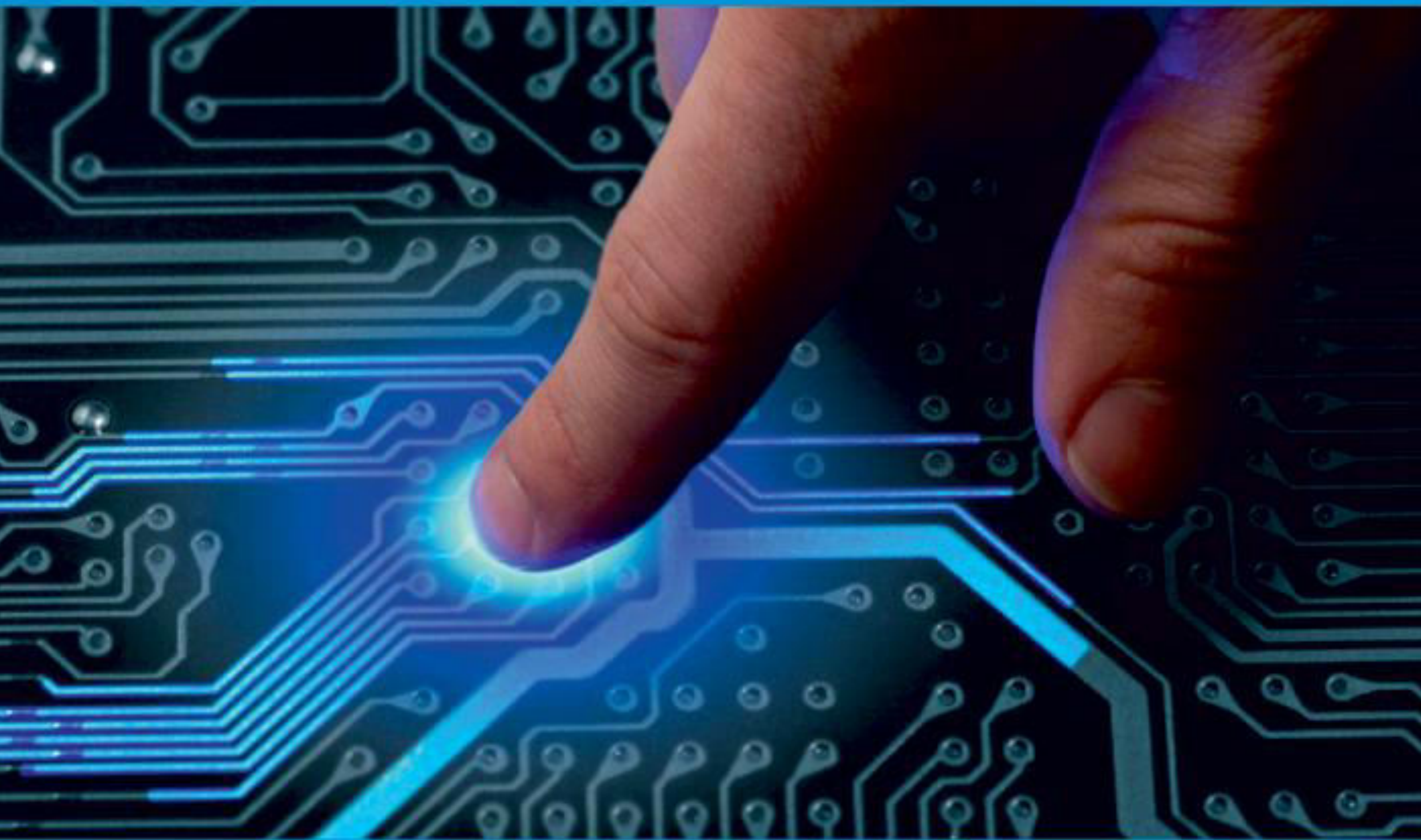

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Emergency Vehicle Classification System

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ABSTRACT: Equipping self-driving cars with a special frame can prevent fatal accidents caused by emergency vehicles caught in rush-hour traffic. This frame clears the road for emergency vehicles to pass. A camera mounted on the rear of the vehicle captures a live view of its surroundings. The computer technology of object identification is related to computer vision and image processing and identifies the occurrence of certain classes of semantic objects in computerized images and videos. ML can be used to recognize and describe elements in images and videos. Organizations and associations today often use vehicle identification as one of their functions. Computer vision can be used to recognize different types of vehicles in videos.

Organizations and associations today often use vehicle identification as one of their functions. Computer vision can be used to detect different types of vehicles in video or in real time using cameras. The Python programming language was used to implement the proposed strategy. Placing emergency vehicles outside can help establish routes for faster arrival. One of the most popular classification methods today is convolutional neural networks. Finally, a trained algorithm decides whether each vehicle should be assigned to an emergency. India is a country with a large population, so there is too much traffic. Emergency vehicles such as ambulances and fire trucks can get stuck in traffic and put lives at risk. This car has priority, so please clear the road. However, it is difficult or even impossible for the traffic police to deal with this problem.

Classifying vehicles as emergency and non-emergency is therefore an important part of traffic monitoring. Self-driving car systems can also easily recognize emergency vehicles, as reaching their destination on time is critical to their service. Such warnings are necessary for self-driving vehicles to clear the way for emergency vehicles. On the other hand, this will give all types of vehicles an immediate warning to reserve space for emergency vehicles. Therefore, there is a need for automated systems that can detect emergency vehicles on busy roads, alert traffic controllers, and automatically move other vehicles out of the way. In this study, we proposed a machine learning-based automated approach for identifying emergency vehicles.

KEYWORDS: Emergency classification system, Artificial Intelligence, Machine Learning, Convolutional Neural Networks, Image Processing, Non-Emergency Vehicle

I. INTRODUCTION

Computer vision research is very difficult. Scientific problems are often not fully resolved. One of the main causes of these challenges is the fact that the human visual system outperforms computer vision systems for some applications (such as facial recognition). Faces are perceived by people under different lighting conditions, perspectives, emotions, etc. Most of the time, it's easy to identify friends from old photos. Furthermore, there seems to be no limit to the number of faces that can be memorized for later identification.

Developing an automated system with such good performance seems hopeless. The tremendous growth of road transport of all kinds in recent years has brought many drawbacks and undeniable advantages. The main drawback of excess traffic is probably increased air pollution. Traffic jams are a regular occurrence in cities due to the increasing number of vehicles and the large number of goods that are trucked in daily. This is a problem not only for large cities with a long history that were not planned for current traffic, but also for relatively new and rapidly growing cities in many developing countries.

The problem will get worse in the future as efforts to improve people's living standards continue. Not only does traffic congestion cause immediate economic losses, it also exacerbates urban air pollution as vehicles drive slowly, producing

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more carbon dioxide and other pollutants. Another problem associated with the increase in cars is parking. Parking spaces are scarce in many cities.The time it takes to find a parking space increases the number of vehicles on the road and increases the already mentioned problem of traffic congestion. The driver information system, which displays information on the number and location of free parking spaces on a bulletin board, is also an excellent tool for optimizing parking space utilization. Solutions to these problems rely directly on data from surveillance systems.

Existing Systems

Traffic problems now days are increasing because of the growing number of vehicles and the limited resources provided by current infrastructures. The simplest way of controlling a traffic light uses timer for each phase in round robin fashion. Another way is to use electronic sensors to capture the location of the vehicle and check whether it is waiting in a signal or not. This method requires installing some sensors in that particular vehicle which is not possible for the huge number of vehicles available.

The use of RFIDs and Bluetooth in the existing work has been used in vehicle detection for a long time. These devices however have a few drawbacks when being used for detecting vehicles:
The number of devices required to install for vehicle detection is increased. Since more devices are bought, the cost is high. Due to the low response speed, the connection takes time to be established.

II. PROPOSED SYSTEM

A. The proposed work involves :

- Implementation
- Training data generation (image level)
- Preprocessing of the images
- Frames extraction
- YOLO detection
- Machine learning algorithms to train
- Validation

A(i). Steps in the proposed work

- Data capturing
- Data processing
- Keras model analysis
- Machine learning (training)
- Classification

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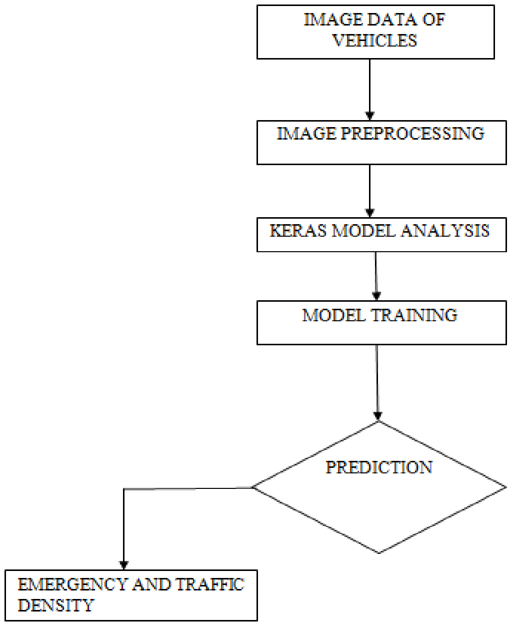

Fig 1.Proposed Methodology

IMPLEMENTATION:
The videos captured by the camera sensor are converted into images and these images are processed by various algorithms and finally, the program gives the output whether the vehicle detected is an ambulance to not. After that it will alert the user if the ambulance is present or not.

TRAINING:
Before the detection of the vehicle and giving output based on the result, the machine must be taught how an ambulance looks like. For this, we created a tiny dataset consisting of a thousand images, and a model must be trained which will be called in the confirmation segment. TensorFlow 2.1.0 algorithm is particularly used to avoid compatibility issues and is installed. Validation and trained images generated after training are stored in their respective folders in google drive and the drive is linked to the training algorithm. Matplotlib is used to give the output graphs.

FRAMES EXTRACTION:
Camera Sensor captures small video clips of traffic; these Clips are taken as input and are sent to the processor. Clips are converted into pictures and are sent for processing. First, they are saved in the "overall" folder of the attached google drive.

YOLO DETECTION:
Images in the overall folder go to the YOLO program that detects if the vehicle is a truck. It is a predefined algorithm that uses the COCO dataset developed by Microsoft. YOLO algorithm detects that the image that is passed through it contains are truck or not.

B. DATA COLLECTION
The UCI repository database served as the source of emergency vehicle records. Three datasets are used in our methodology. You can find photos of the vehicle in the test category. Images of training-related vehicles are displayed in the train. Post example. Contains the title of the image and indicates whether the image is of a rescue worker. There are many databases that already contain photos of emergency services such as ambulances, fire trucks, and police cars.
Most often, these databases are collected for very specific applications using neural network models designed to classify vehicles based on some of these characteristics. In our research we want to classify two different types of cars.

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In practice, we need the ML algorithm to be able to extract features from the data on its own, but this is usually only possible when large amounts of training data are available, especially for problems where the input sample is extremely multidimensional. is possible. As B. Photo. There are a total of 2000 photos in the database, of which 1500 were used for training and 500 for testing.

C. PREPROCESSING OF DATA

Data preparation is essential when working with neural networks and machine learning models. We used the Get Transforms and Image Data Bundle utilities to standardize the photos in our work. Images are saved in JPEG format. Get transform.In fact, it's often easiest to use Get-Transforms to get a collection of default-configured transforms that perform well for different tasks. The user may want to change some arguments. The most important of these are:If true, a random rotation of the image will be applied (default behavior). Restricts rotation to 90 degree and horizontal rotations only (if False) or horizontal and vertical rotations and 90 degree rotations (if True). if not None, a random rotation between - max_rotate and max_rotate degrees are applied with probability p_affinemax_lighting:if None is selected, a random lightning and contrast change controlled by max_lighting is applied with probability p_lightingmax_warp:if there isn't None, a random symmetric warp of magnitude between - max_warp and max_warp is applied with probability p_affineget_transforms return a tuple of two lists of transforms:one for the training set and one for the validation set (the validation set's images shouldn't be altered, therefore the second list of transforms just includes image resizing).

In order to define a Data Bunch object and start training a model, this may be given directly. The defaults forget transforms are often rather fine for standard photographs, but in this case, we'll add a little more rotation to make the changes more obvious. Prior to beginning work, a dataset must be transformed into a Data Bunch object, and in the case of computer vision data, precisely into an Image Data Bunch subclass. The Image List class and its subclasses are used in conjunction with the data block API to accomplish this. However, Image Data Bunch also provides a collection of shortcut methods that encapsulate many steps of the data block API into a single wrapper function. these techniques are used for:

ImageNet-style data set (Image Data Bunch.from_folder) Pandas data frame with a column of filenames and a column of labels. It can be a string for classification, a label_delim delimited string for multiple classifications, or a float for regression problems. (ImageDataBunch.from_df) File name and list of methods to get destination from file name (ImageDataBunch.from_name_func) List of filename and regex patterns to get destination from file name (ImageDataBunch.from_name_re) bs (int): Number of samples to load per batch (batch size overrides bs if batch size is specified). This record is accepted if bs=None. get item returns the stack. Number of workers (integer): How many subprocesses should be used to load the data? 0 indicates that the data is loaded into the primary process. valid_pct specifies the percentage of the entire image to use for validation. set.ds_tfms is a tuple of two lists of transforms to use for the training and validation sets (and optional testing). fn_col is the index (or name) of the column containing the filename. label_col is the index (or name) of the column containing the label. tfms is a transform applied to the DataLoader. The size and kwargs are passed to the transform for data augmentation.

D. IMAGE PROCESSING

Image processing is the art of applying various processing to images in order to enhance them or to obtain certain desired details from them. It is a form of signal analysis in which an image is the input and the result is either another image or an attribute or feature associated with that image. Image processing is one of the technologies that are rapidly spreading today. This is a major research topic in both engineering and computer science. Import images using an image capture tool. Evaluate and change your image. Results, which are statements based on transformed images or image analysis, are her three main components of image processing.

Analog image processing and digital image processing are two categories of image processing. Analog image analysis is possible for printed materials such as prints and images. When applying these perceptual approaches, image

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analyzers use several interpretation bases. Computer-aided digital image processing is made possible by using digital image processing tools. When using digital methods, all types of data must go through three important phases:

- Pretreatment
- enrichment
- presentation

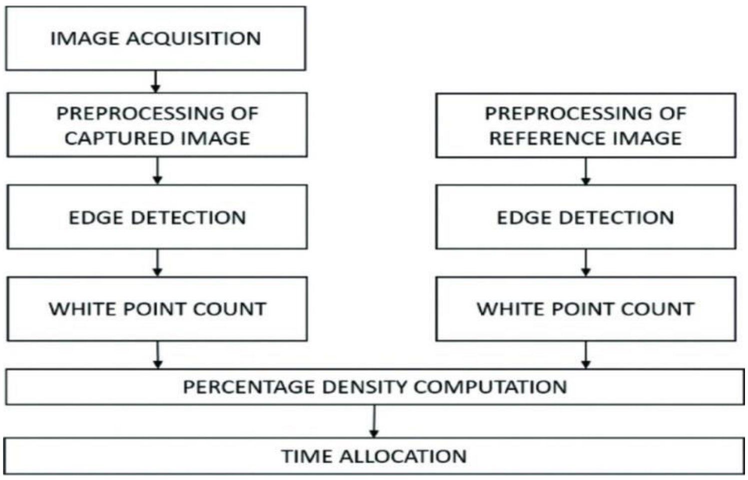

Fig 2. Image processing algorithm for estimating traffic density

E. MACHINE LEARNING:

ML is a subject that relies on studying computer algorithms to understand and advance byitself. Computer vision works using artificial neural networks that are created to mimic way people consider and learn, whereas machine learning employs fewer principles. Until recently, the complexity of neural network models was constrained by computational capacity.

Bigger, more complicated neural networks are now possible because to developments in big data analytics, which computers in the company to watch, understand, and respond to complicated matters quicker that of people. Voice recognition, language processing, and picture categorization have all benefited from machine learning. Any pattern matching issue may be resolved with it without the requirement for human interaction.

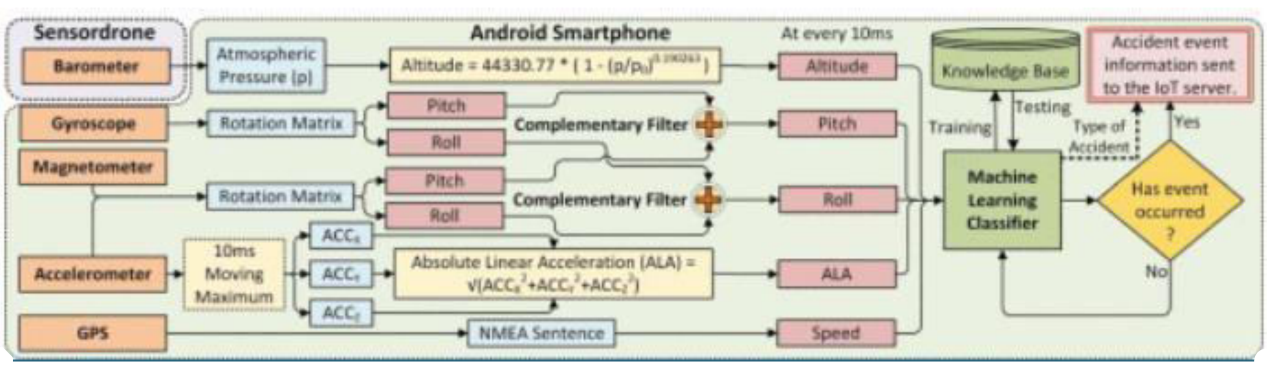

Fig 3. Workflow diagram of the accident classification using machine learning

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III. TRAINING & RESULTS

A. TRAINING

Since we have our data ready so it's time to feed it into a model. We can do this by building a convolution neural network from scratch but doing this would be practically inefficient. So, we take the weights of a pre trained CNN model that has learnt to recognize features (certain kind of things e.g., gradient, edges circles etc.)

Here we would be using a pre-trained ResNet50 Convolution Neural Net model and use transfer learning to learn weights of only the last layer of the network.

Transfer learning is when you begin with an existing (trained) neural network used for image recognition — and then tweak it a bit (or more) here and there to train a model for your particular use case, we do this because training a neural network from scratch would mean needing approximately 300,000 image samples, and to achieve *really* good performance, we're going to need *at least* a million images. But with transfer learning we can achieve high performance with limited data set and in much less time.

We would be fine tuning it by keeping some layers frozen and unfreezing some of them and training over it. This is because the top layers learn simple basic features and we need not to train those layers, while the later layers learn more sophisticated features.

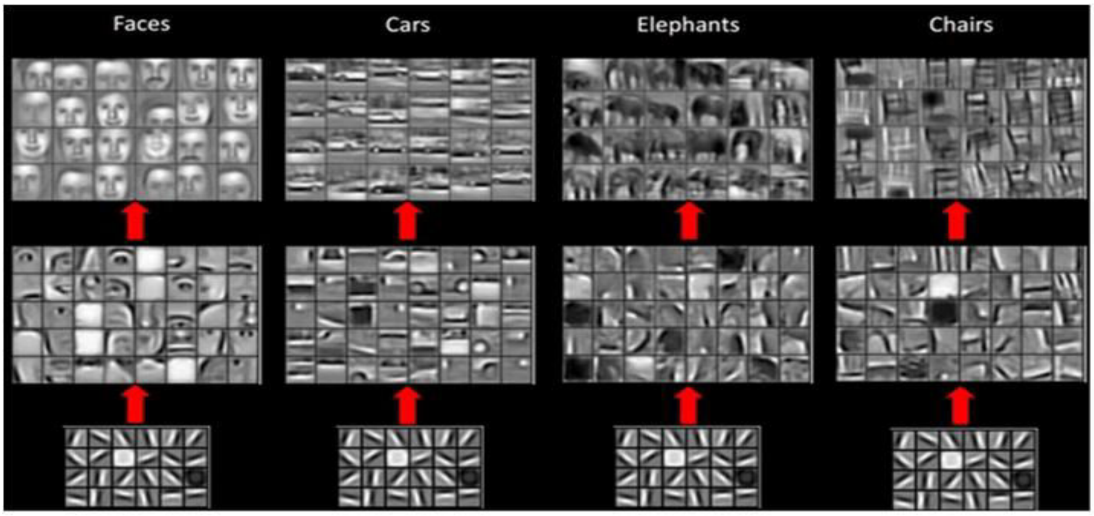

Fig 4. representation of features in 3 layers of a CNN

In the above picture each different layer learns different features of the images. The latter layer of the convolutional neural network learns features like faces of humans, shapes and sizes of cars, elephants etc.

B. Results

Two columns are present. the emergency_or_not column, which includes the labels for each image, and the image_names column, which contains the names of the photos. Here, the label for an emergency vehicle is 1, whereas the label for a non-emergency vehicle is 0. This brief examination of the data frame gives us enough details to load the data and begin developing our image classification model, but before we do so, we will alter the photos in order to assist us generalize our model and achieve high accuracy.

IV. CONCLUSION AND FUTURE WORK

Our approach can be integrated with CCTV to monitor emergency vehicles and provide them precedence in traffic so they may pass. Establishing emergency service skills for the nighttime and inclement weather is difficult but equally important to react inclement weather. Therefore, further study in this area is necessary for a full EV detection algorithm. The primary characteristics that may be utilized for eyesight recognition are the emergency vehicle's blinking lights because the form of the vehicle is scarcely apparent at night.

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Additionally, emergency vehicles provide audio elements which can serve as a wealth of information. Whenever there is heavy traffic, audio characteristics are recorded well in advance of the arrival of the rescue vehicles. Therefore, combining audio characteristics with vision-based approaches could result in more accurate emergency vehicle detections.

Furthermore, research can be done to capture an image from a live video and detect the ambulance, as videos given as an input by the user. Our model can be embedded with CCTV to track emergency can and give priority in that road to pass the emergency can. Developing emergency response capabilities during the night and off-nominal weather conditions are challenging and as essential as response during normal weather conditions. Hence research into this is essential for a complete EV identification system. Since the shape of the vehicle is hardly visible in the night, the predominant features that can be used for vision-based identification are the flashing lights on the emergency vehicle.

Thus, an extension of this work can also aim at developing algorithms to identify EVs during night- time by capturing these flashing light features. This work has mainly focused on developing emergency vehicle identification using vision-based techniques. Emergency vehicles also output sound features that can act as a rich source of information. In crowded traffic scenarios, sound features are captured much before when the emergency vehicles are in the line of sight. Thus sound- based features when fused with vision-based techniques can also lead to more robust emergency vehicle detections.

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