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Road Accident Detection System

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Abstract

This paper aims to help the unfortunate victims of a road accident by alerting the nearest medical authorities as soon as possible. Through this paper, we have trained a model to detect vehicles and people through the real time C.C.T.V footage of a road and more importantly an accident which has occurred using a convoluted neural network known as YOLO v3 which is based on Darknet.

Keywords: *YOLO v3, Detecting system, road accident*

1. Introduction

Road connectivity in India is increasing at a rapid rate. Road length in India has increased from about 4 lakh kilometres in the 1950s to about 55 lakh kilometres in 2015. The number of new vehicles entering the road every day is also on the rise. Unfortunately due to negligence and lack of facilities to ensure safety of those on the road, the lives of the citizens of our country are affected. In 2015 alone, there were about five lakh road accidents in India, which killed about 1.5 lakh people and injured about five lakh people.

After an accident has occurred, many victims do not receive proper medical assistance at the right time. Many cases have resulted in patients being brought into the hospital already dead. One of the main reasons is because the emergency medical services were not alerted at the time.

Resources used to control road traffic are unable to provide help to the victims of an accident as there is no reliable system in place to detect an accident when it happens. However smart road accident detection systems have been proposed before which made use of the Arduino UNO[2][8] and an IR sensor[2] or a gyroscope sensor and a heart sensor [8] linked to it. Some proposed systems used other wearable devices along with vehicle mounted sensors to detect accidents [10].

Another very interesting approach to accident detection was proposed which made use of a particular algorithm which extracted attributes of each frame of the real time accident footage. It not only helped detect accidents but also classified the types of vehicles involved [6].

This paper utilizes the existing neural network systems to create a model which would be able to accurately detect accidents occurring on the road in real time along with vehicles and people, if present.

2. Literature Survey

Deeksha Gour et.al (2019) [1] proposed a paper to make an advanced traffic monitoring system which can identify and detect moving objects such are cars, bikes etc in live camera feeds and detect collision of these moving objects and immediately send emergency alerts to the nearby authority for them to take necessary actions.

Naji Taaib Said et.al (2018) [2] proposed a paper to detect accidents and to create a prevention system to reduce Traffic Hazards using IR Sensors

Md. Fahim Chowdhury et.al (2018)[3] have proposed Real Time Traffic Density Measurement using Computer Vision and Dynamic Traffic Control which is a dynamic traffic control system by measuring the traffic density at the intersections by real time video feeds and image processing.

Liang-Bi Chen et.al (2018) [4] proposed an Implementation of Deep Learning based IoV System for Traffic Accident Collisions Detection with an Emergency Alert Mechanism

Joseph Redmon et.al [5] proposed a paper to present some updates to YOLO. It shows the design changes which have been made to improve YOLO.

Gargi Desai et.al (2018) [6] have proposed smart road surveillance using Image Processing through which they can detect accidents in Real time C.C.T.V footage and alert the hospital by sending the data to the traffic monitoring centre.

Shaohu Tang et.al (2018) [7] have proposed Urban Traffic Cooperative Control based on Regional Division by first dividing the peak traffic network into oversaturated region and its associated areas, and the grey relational analysis and spectral clustering method are used to divide the associated areas.

Nagarjuna R et.al (2017) [8] proposed a paper tomakean affordable and reliable automatic accident prevention system using GPS module, Gyroscope sensors and Arduino UNO R3.

Nicky Kattukkaran et.al (2017) [9] proposed a paper to implement an Intelligent Accident Detection and Alert System for Emergency Medical Assistance using an accelerometer within the vehicle and a heartbeat sensor which is on the driver. They are both connected via Bluetooth to an Android application to alert the friends and family of the driver.

Venkata Krishna et.al (2017) [10] proposed an Automated Accident Detection and Rescue System using a Smart phone and Devices having Accelerometer, Bluetooth.

3. Implementation

This paper has been implemented using YOLO v3 in a Microsoft Windows environment. YOLO v3 is a custom real-time object detector system. YOLO stands for You Only Look Once. It is based on Darknet which is an open source neural network framework written in C and CUDA.

System Requirements

A. Software Requirements

- Python 3.7
- Opencv 4.2.0
- CUDA 10.0
- OpenLabeling
- YOLO v3

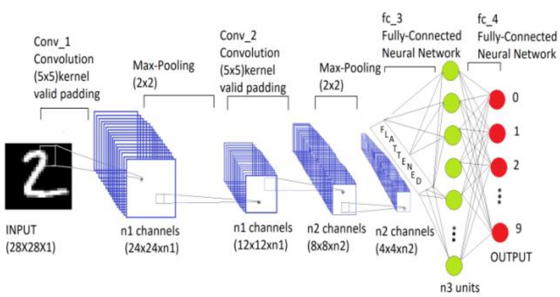
B. Hardware Requirements

- Intel i5 or i7 processor
- NVIDIA GEFORCE GTX 1050 GPU
- 8GB RAM

As YOLO v3 has a **convolutional neural network** architecture, here is a brief overview of it.

Convolutional Neural Networks

Given below is the architecture of the popular CNN sequence of classifying handwritten digits.



A Convolutional Neural Network is a Deep Learning algorithm which can accept an input image and assign some weights to certain objects or aspects within the image. As a result. The pattern of connectivity is similar to that of the neurons in the brain.

Each layer of the network is responsible for extracting certain features of an image. The first layer would extract basic features such as color and edges. With added layers, the architecture adapts to the High-Level features as well, giving us a network which has the wholesome understanding of images in the dataset, similar to how we would.

The component associated with doing the convolution activity in the initial layer of a Convolutional Layer is known as the Kernel.

Pooling, as show in the figure above is used to reduce the computational power required to process the data through dimensionality reduction and extracting certain dominant features. Max Pooling suppresses noise as it returns the maximum value of that part of the image covered by the kernel.

Such a network can help in reducing the images of a dataset into a form which is easier to process without losing those features in an image which are critical for detection.

Step1: Creating a dataset

To create the dataset, we downloaded the C.C.T.V and dashcam footage of road accidents. These videos included accidents involving cars, bikes, buses and trucks. The videos were split into individual frames and labeled with the help of OpenLabeling, an open source image and video labeler. The redundant frames were first filtered out and the objects of the remaining frames were labeled under three classes.

The three classes are:

i) Person
ii) Vehicle
iii) Accident

For each image, a .txt file was created with the same name as that of the image. It contains the coordinates of the bounded boxes of the objects along with the classes they belong to.

Both the images and their respective .txt files make up the dataset.

Step2: Training the model

We trained the model using the created dataset with the help of YOLO v3. A sufficient number of 2000 iterations for each class is necessary. As a result we had 6000 iterations.

This graph for the varying levels of average loss(error) was created during training.

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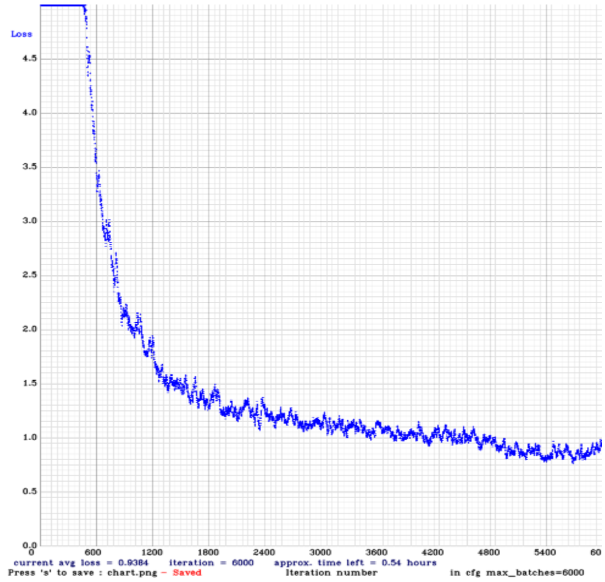
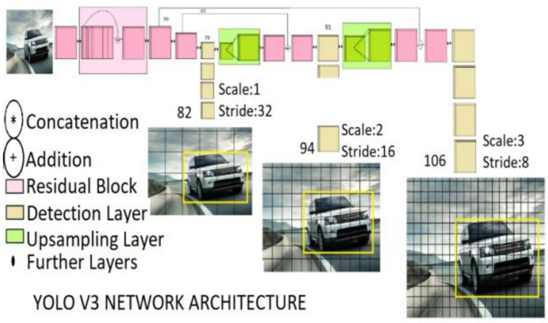


The final average loss could range from 0.5 (for a small and easy dataset) to 3.0 (for a large and complex dataset).

At the end of training, our current average loss was 0.9384.

During training, weights files were created after every 1000 iterations. We could choose any of the last few .weights files for testing.

Step 3: Testing



YOLO v3 utilizes a variation of Darknet, which initially has 53 layer organize trained on Imagenet. For the errand of detection, 53 additional layers are stacked onto it, giving us a 106 layer completely convolutional basic system for YOLO v3 [5].

The most remarkable component of v3 is that it makes detections at three distinctive scales which are given by downsampling the components of the picture by 32, 16 and 8 respectively. The initial scale is liable to detect fairly large objects and the final scale detects the smaller objects while the second scale detects the medium sized objects. An image is divided into multiple grids and each grid makes 3 predictions using 3 anchor boxes. So there are 3 layers therefore the total number of predefined anchor boxes is 9. These anchor boxes are chosen using K-means clustering [5]. A cell is selected if the centre of an object falls in the receptive field of the cell.

YOLO v3 is slower compared to the v2. This is because of the 106 convolution neural network layers. However it is more accurate as it detects small objects. An accident detection system was proposed in the past which used the older YOLO v2. It had just 24 layers [1]. The upsampled layers when concatenated with previous layers, the fine grained features which are essential to detect such objects were maintained.

After the training was completed, we tested our model with several such videos and images and it was able to successfully detect the objects with considerable accuracy.

4. Future Work

i) This paper can be further improved by automating analert response to the nearest hospital or ambulance service after detecting the accident through the CCTV footage. The medical authority will be provided with live footage of the accident so that they can decide on what kind of ambulance should be sent and the number of ambulances and such. They could also be provided with the G.P.S location of the accident. There are systems proposed which makes use of a GSM module for communication and to send alerts to the nearest medical facility and the family of the victim [8]. Some systems have an android application which is linked to the sensors within the vehicle such as an accelerometer [9]. When abnormal values are recorded by the sensors, the application begins to send alerts.

ii) Every accident alert can be recorded and a report can be generated which marks the accident prone zones and accident prone times. The reports on the frequency of accidents along with the zones and timings would help the necessary authorities while investigating such zones and implementing safety measures.

iii) As the model can already detect vehicles, a traffic intensity report can be generated for a particular period of time. This can help the traffic police make use of their resources and man power more efficiently to ease the flow of traffic. Traffic density measurement systems have been

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proposed before which made use of Computer Vision and Gaussian algorithms. They detected a vehicle by detecting the movement of its centroid[3].

5. Conclusion

This paper and it's improvements would definitely help citizens in times of need and can save valuable time. Traffic can be controlled in a much more convenient manner.

However safety of ourselves and those around us is a social responsibility. Such advancements in technology cannot curb negligence in humans but can just provide help after an incident has occurred. It depends on each of us to behave on the road in a patient and cautious manner.

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