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Enhancement of Potholes Detection using SSD Algorithm

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Abstract: ***The development of self-driving cars has always been an extensive research field for the automotive sector. To make a efficient self-driving car, many challenges need to be resolved. Detection of road condition is one of them. This research paper focuses on a particular part-detection of potholes using a camera and analyzing the video feed with the help of artificial intelligence. To solve this problem a popular and weightless algorithm, SSD (Single Shot Multibox Detector) is used.***
Keywords: Artificial Intelligence, Convolutional Neural Network, Automobile industry, Single Shot Multi Box Detector, Algorithm.

I. INTRODUCTION

Millions of dollars are spent on maintaining and repairing potholes by municipalities around the world. A pothole is a small depression in a road's surface, caused by activities such as weather, traffic, and other variables. There are significant issues with the transportation system. These problems, even though they appear to be less significant as an individual issues add up to big issues when combined in a cumulative, collective, and in a broadsense. The issues that these potholes created result in low fuel economy, accidents, traffic jams etc., which have an adverse impact on the economy of a country and day to day citizens' lives. The number of reported accidents is exponential increasing due to poor road conditions. Roads degrade with increased use and lesser maintenance.Due to the poor road conditions, difficult for drivers to judge road conditions**.** It is hazardous to travel by road without any warning sign, especially at the night. Maintenance is required to avoid such accidents, system is required which will detect the potholes, bumps, etc. on the road surface before it is encountered so that the drivergets enough reaction time. We need to develop a system for that will detect the defects on the road. The main motivation behind potholes detection method is to aid drivers in various aspects and thus assist them in avoidinga possible accident. All these reasons increase the need to obtain information of such bad road conditions and their remedy. The system automatically recognizes such holes and fills them in order to maintain the road condition. Potholes are depressions rather than growth.

II. METHODOLOGY

A. Applied Object Detection

The object recognition process worked under different variations of input data pose, occlusion, viewing angle, and lighting conditions. The pipeline object detection model can be divided into three parts: informative region selection, feature extraction, and classification. A pipelined object detection model can be divided into three parts:information region selection, feature extraction, and classification. Use Informative Region Selection to change the size, aspect ratio, or specific location of objects that may be present in the image. Therefore, we scan the entireimage using a multiscale sliding window. Its computation is considered expensive because there are unlimited redundant candidate windows. On the other hand, applying only a certain number of sliding window templates can detect underperforming regions. Feature extraction requires robust, four semantic representations to extract visual features in order to recognize different objects.

B. Single Shot Multibox Detector (SSD)

SSD is an object detection model. Published by Google researchers in 2016. It uses a single deep neural network that combines feature extraction and region suggestion.

C. Datasets

It consists of different datasets of pothole images.

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D. CNN?

The concept of CNN is that neurons in one layer only connect to neurons in adjacent layers and not to neurons in the next layer. The number of neurons required to process the entire complex problem is very large, and this is known as overfitting. Previously, all hidden layers were associated with individual nodes. CNNs are like other neural networks, but with learnable weights and fundamentals. So, each neuron receives multiple inputs, takes their weighted sum, goes through an activation function, and finally responds with an output.

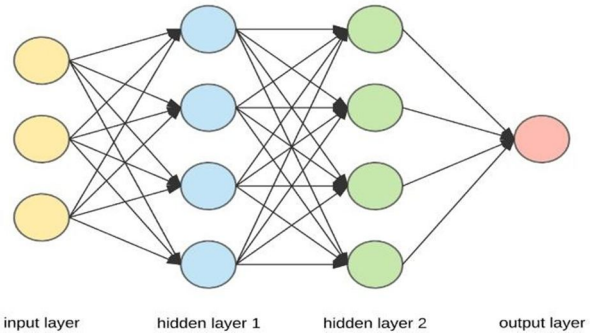


Fig.2.1. Convolutional Neural Network

III. LITERATURE REVIEW

More than 9,300 people have been killed and nearly 25,000 injured in road pothole-related road accidents in India.This is a serious concern given that pothole accidents are on the rise, far outstripping terrorist attacks. It isunacceptable that many people die because of road potholes. Constant detection and timely repair can not onlyensure road surface quality but also save many lives. Many proposals are collected from standard journals and first chronologically checked to find contributions to pothole and bump detection technology.

After review, various issues in road maintenance are discussed. We describe and review different approaches used in pothole detection. To identify road potholes, the following approach is recommended: A vibration-based approach to automatically detect potholes with coordinates, a stereo vision system to detect potholes while driving, and anIoT-based road monitoring system (IoT-RMS). in the street. As a result of the research, case studies are includedand reviewed. The development of self-driving cars has always been an extensive research field for the automobile industry. To make a capable self-driving car, many challenges need to be resolved. Detection of theroad condition is one of them.

The project focuses on a particular part-detection of potholes using a camera and analyzing the Video feed withthe help of artificial intelligence. To solve this problem a popular and lightweight algorithm, SSD (Single Shot Multi box Detector) is used. Fast single shot multibox detector and its applicationon vehicle counting system. The technology of intelligent transportation system (ITS) application has been developed rapidly Pothole Detection under Diverse Conditions using Object Detection Models. This projectproposes a pothole detection method to detect and localize potholes on road surface. They have described thedevelopment of a Faster RCNN modelfor pothole detection which is trained on a public potholes data set. Theycompare the result of a self- built CNN model with pre-trained CNN models, with the pre-trained model achievingan overall detection accuracy of 97.8%. Pothole Classification Model Using Edge Detection in Road Image. Inthis project, we propose a pothole classification model using edge detection in road image.

The proposed methodconverts RGB (red, green and blue) image data, including potholes and other objects, to gray-scale to reduce the amount of computation. It detects all objects except potholes using an object detection algorithm. The detected object is removed, and a pixel value of 255 is assigned to process it as a background. In addition, to extract the characteristics of a pothole, the contour of the pothole is extracted through edge detection.

Finally, potholes are detected and classified based by the (you only look once) YOLO algorithm. Coupled Object Detection and Tracking from Static Cameras and Moving Vehicles. In this paper, they have presented a novel approach for multi object tracking that couples object detection and trajectory estimation in a combinedmodel selection framework. Their approach does not rely on a Markov assumption, but can integrate information over long time periods to revise its decision and recover from mistakes in the light of new evidence. As their approach is based on continuous detection, it can operate with both static and movingcameras and cope with large-scale background changes.

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IV. MODELING AND ANALYSIS

Looking at various methods of object detection these days, convolutional neural networks are used to improve thespeed and accuracy of detection. Among numerous computer vision object detection methods, single-shot multibox detectors are fast and powerful compared to other models. This is because the SSD model's algorithm uses multiple convolutional layers to detect objects. The concept behind a single-shot multibox detector, a feedforward convolutional neural network, helps us obtain multiple fixed-size bounding boxes. Then an object class instance is searched with the given input to get the final unsuppressed maximized output, thus removing theextra anchor boxes. Various auxiliary layers and additional prediction layers are convolved.

1) To predict different aspect ratios and scales per layer, we reduce the size of additional convolutional layers to improve the accuracy of the prediction model.

2) CNN generates multiple feature maps by extracting the most relevant features from the input image usingmany kernels or feature detection layers (sharp kernel, edge detection kernel, blur kernel, etc.).

3) The extracted feature map layer is associated with a bounding box that helps locate objects within a giveninput. These are the actual SSD layers, also called SSD heads.

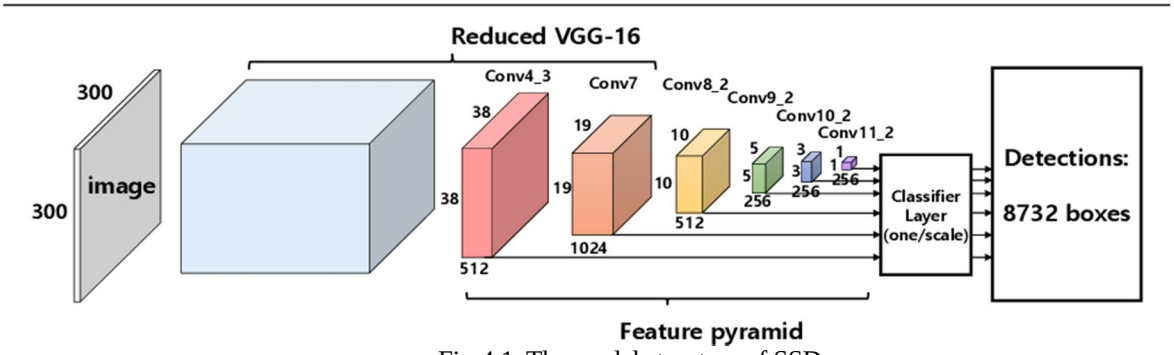


Fig.4.1. The model structure of SSD

V. RESULTS AND DISCUSSION

Before going into the single-shot multibox model, we need a sample image marked with a ground truth box that covers the pothole area. For example, Figure 4.1 shows an example of an image with a box delimiting an indentation.

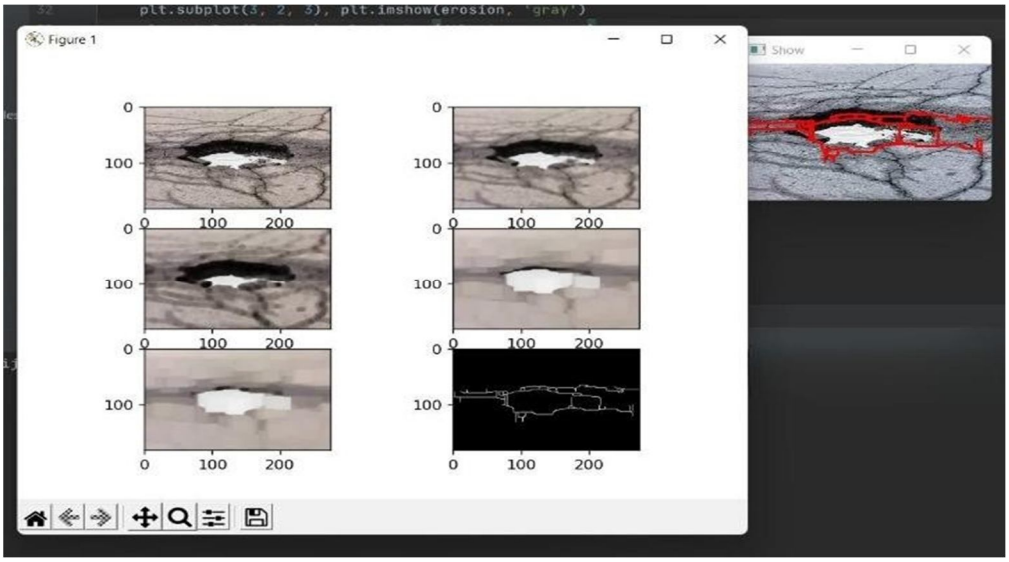


Fig 5.1 Image with Pothole Detection

The first and most important is the union of these two boxes. H. As a result of matching or intersecting predictionboxes and base truth boxes, the maximum intersection value on the union is obtained. In this way, SSD helps youfind objects and their positions by creating a frame around them.

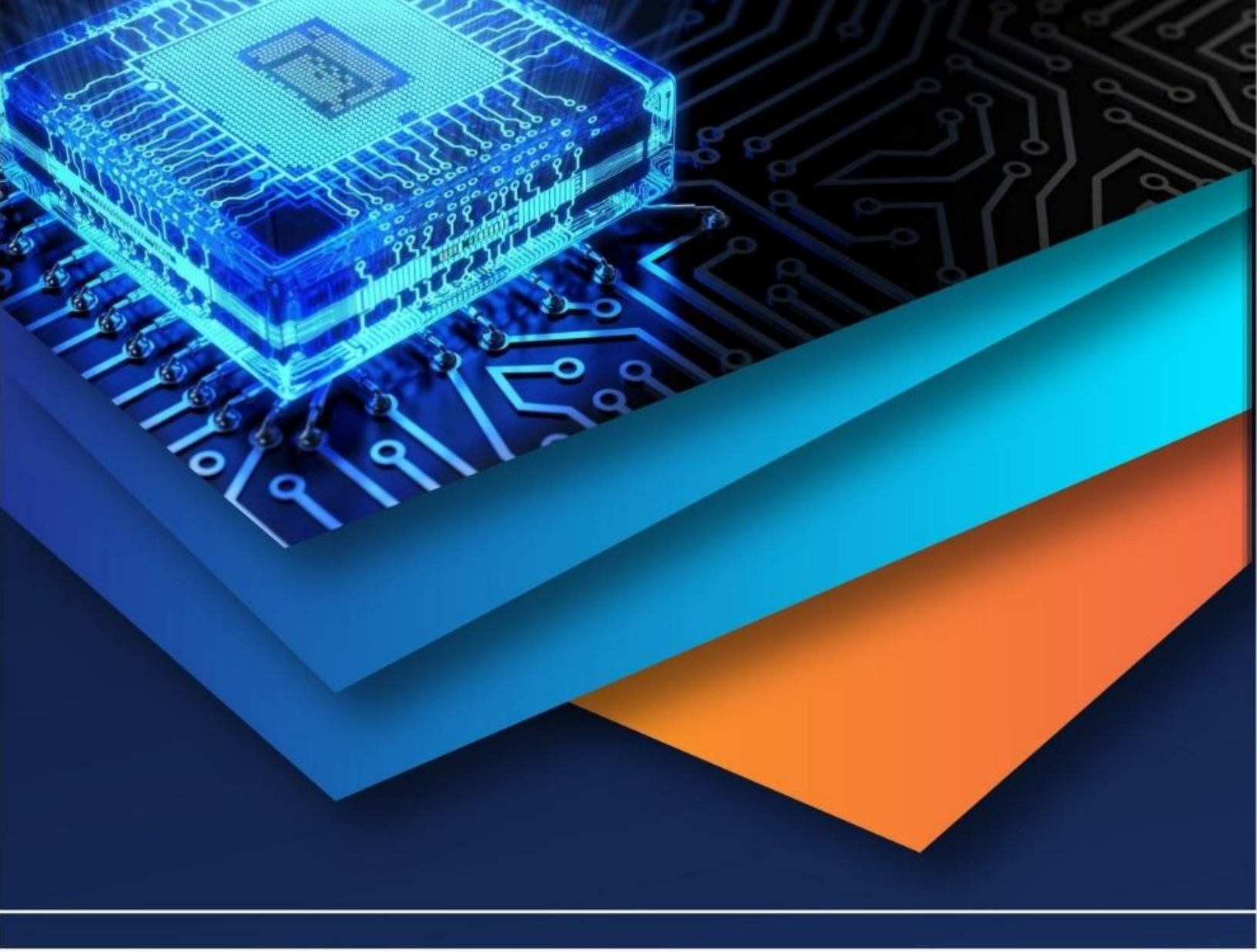
VI. CONCLUSION

Object detection using SSD algorithms is the main one and has been successfully achieved. The SSD algorithm is the most advanced algorithm in computer vision for object detection. The concepts used in CNN make it fast compared to other algorithms used for object detection. The SSD model not only recognizes it, it helps you find the object. After training a dataset, you can expect to get the best possible results.

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