Real-time Obstacle Detection and Object Tracking using Machine Learning Techniques

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Abstract : - Identify the real-time obstacle that plays a key role in everyday life. With the use of a camera, we attempted to identify many obstacles in a single frame in this paper. In this paper we use classifiers to classifies objects: K-nearest neighbor (KNN), random forest, and decision tree. Determine if the obstacle is static or dynamic using the above classifiers, then compare the results and also if obstacle is dynamic then object tracking process can be done.

IndexTerms - **K-nearest neighbor, Random Forest, Decision tree, CNN.**

1. INTRODUCTION

The main goal of this project is to create, test, and refine a model that can identify many items in a frame, locate them, and classify them based on their classifications. The goal is to train the model by labelling the dataset, and then the trained model will be able to predict the outcome. We will need to know about convolution neural networks, digital image processing, and object classification for this project. We also discuss how understanding neural networks can aid in identifying objects and how they are represented in a computer.

A neural network be machine learning technique that is evolved from how biological neural networks are organized and operate. Neurons are the fundamental components of neural networks. The layers neurons are linked to the adjacent layers neurons. From the input layer neurons to the output layer neurons, data goes.

Convolutional Neural Networks were mostly employed in this research. A CNN is referring to artificial neural network that are specifically designed to process pixel input and is used in image recognition and processing. One or more convolutional layers can be found in a CNN. The network is typically significantly deeper but with far fewer parameters as a result of this convolutional procedure. Convolutional neural networks have shown to be particularly effective in image and video recognition, speech processing, and recommender systems as a result of this capacity.

As we must choose a large number of regions, this could be computationally expensive. There's also the issue of ratio. Thousands of items in various shapes are usually present, for example, a seated dog has a different ratio than a standing or sleeping dog. As a result, technologies such as Region-based convolutional neural network, You Look only Once, and Others will be created to seek out and locate these instances rapidly.

Faster R-CNN is a technique of deep convolutional network for object detection and classification that appears to the user as a single, end-to-end, unified network. Running CNNs on a large number of patches created by window detector was unfeasible. R-CNN overcomes this challenge in Selective Search object technique, here it reduces the amount of bounding boxes available in classifier. Selective search uses local clues such as texture, intensity, brightness, and etc, among other objects, to seek out all possible locations for the thing.
such boxes will now be clad within CNN-based classifier. Remember that the F-CNN component requires a hard and fast sized input, so we resize all the created boxes to 224x224 for VGG and feed to the CNN section (without retaining aspect ratio).
R-CNN consists of three major phases.

- To locate suitable objects, we can employ a network-like selective search.
- To get the results of each patch, we can feed them into CNN, which is then followed by an SVM classifier.
- Finally, optimize the result patches separately by training bounding box regression.

In this paper we mainly concentrate on You Only Look Once, Version 3 (YOLOv3) is a real-time object detection tool that recognizes specific things in films, live streams, and photos. YOLO v3 forecasts on three levels, that are precisely determined resampling size of image input into 32, 16, and 8 pixels, respectively. The result would be a draw a bounding box together along their classes been identified. Six numbers of parameters are assigned to each bounding box (pc, bx, by, bh, bw, c).

Model	Train (DATASET)	Test	mAP	FPS
YOLO	VOC 2007	2007	63.4	45
Fast Yolo	VOC 2007+2012	2007+2012	52.7	155
YOLOv2	VOC 2007+2012	2007+2012	76.8	67
YOLOv2 544x544	COCO trainval	Test-dev	78.6	40
Tiny YOLO	COCO trainval	Test-dev	57.1	207
YOLOv3-320	COCO trainval	Test-dev	48.1	45
YOLOv3-416	COCO trainval	Test-dev	55.3	76
YOLOv3-608	COCO trainval	Test-dev	57.9	20
YOLOv3-tiny	COCO trainval	Test-dev	33.1	220
YOLOv3-SPP	COCO trainval	Test-dev	60.6	20

Table 1. The performances of the different versions of YOLO.

2. LITERATURE SURVEY

Author concludes in this paper that object detection can be done by using single neural network and also YOLO technique used. In other algorithm completely image cannot be identified but in YOLO object detection completely using convolutional neural network but disadvantage is less accurate in their result and also percentage classify the object is not done properly [1]. this paper proposed object detection can be done by using OpenCV libraires and packages, also used convolution neural network and SVM classifier then output is predicted by helping of bounding box and accuracy graph will be generated. Here disadvantage of this paper is In crowd scenarios, the detector's performance needs to be overhauled. less accurate results in crowd scenarios. Compare classifiers are not done [3]. Author create a framework for real time object detection of type unmanned aerial vehicle with help feature extractions then feature of object represented by two factors that high- and low-level deep feature map along with bounding boxes can be predict disadvantage is only identifies the unmanned object [2]. This article proposes using a neural network, presents a data-oriented method for recognizing barriers in outdoor railway scenes. The RCNN and stochastic gradient descent methods are employed to detect the barrier. Disadvantage of this paper it does not detected small object and also it works only in fixed number of objects [4]. author suggest that object detection done by ground plane extraction, feature extraction, and texture extraction using this image processing technique and also vision-based technique is used here there are two kind one is stereo and monocular technique. Disadvantage of this paper is no built real time application and also less accurate in results [5].

Gap analysis:

- In research papers only few parameters used for prediction, but in the proposed system we use more parameters.
- In research paper they have presented an idea of prediction the obstacle detection, but we implement this concept as a real-time application beneficial for visually impaired persons, self-driving cars, and other applications.

3. PROPOSED METHODOLOGY

The proposed system is an automation for real-time multiple obstacle detection in a single video sequence, while it predicts with the help of boundary box prediction and also identifies whether the obstacle motion is static or dynamic. For object classification, we employ a supervised learning algorithm. Parameter used: Height of an image. Width of an image.

Machine learning is a data-driven method of examining a system. Machine learning is a branch of data science in which data can be processed using machine learning algorithm.

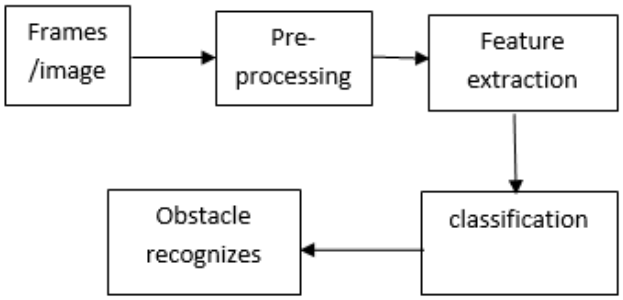

Fig -1: Block diagram of obstacle detection.

In above diagram describes the capture a frame assistance with camera, then pre-processing a frame to reduce noise, then feature will be extracted with the help height and width of the image and add classifiers to classify the object.

3.1 Random Forest

Random forest algorithm is also one of efficient algorithm which works on classification of object and it require less time compare the other algorithm for classify the object. A RF incorporates two essential elements that give it the term random, rather than just averaging tree prediction:

• When building trees, a random sample of training observations is used.
• Random feature subsets for splitting nodes.

Working of random forest classifier:

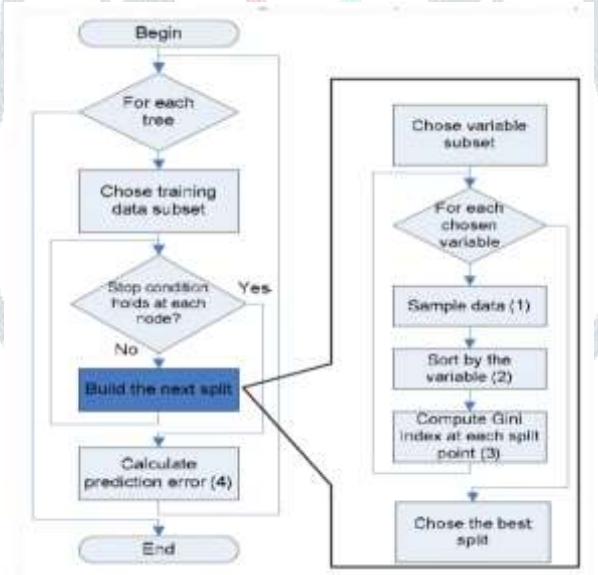

Fig -2: flow chart diagram of random forest classifier.

3.2 Decision tree learning algorithm

The decision tree is an algorithm which works on classification of an objects. In this tree-like hierarchical classifier, here in tree internal nodes consider has a dataset property, edges indicate decision rules, and all leaf node delivers the output of classification.

Working of Decision Tree algorithm:

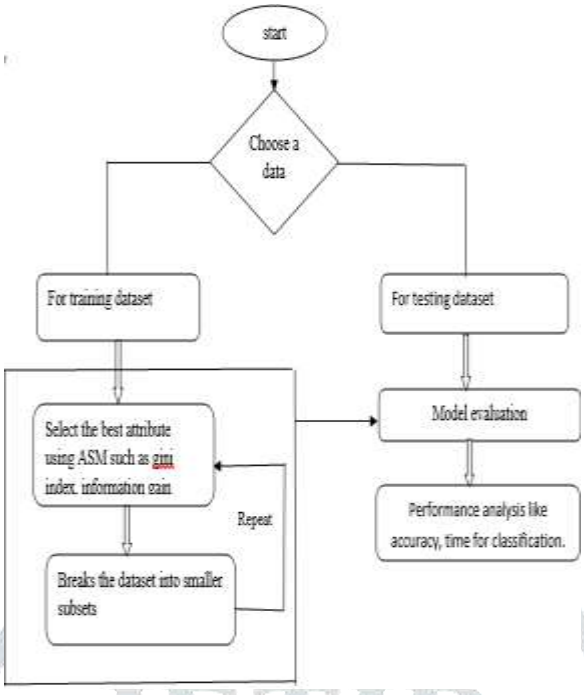

Fig -3: flow chart diagram of detection tree classifier.

3.3 KNN (K -Nearest Neighbor) algorithm

The KNN algorithm is an only algorithm it is efficiently works on numerical and image dataset. In this paper KNN is used for image classification purpose.

Working of KNN algorithm:

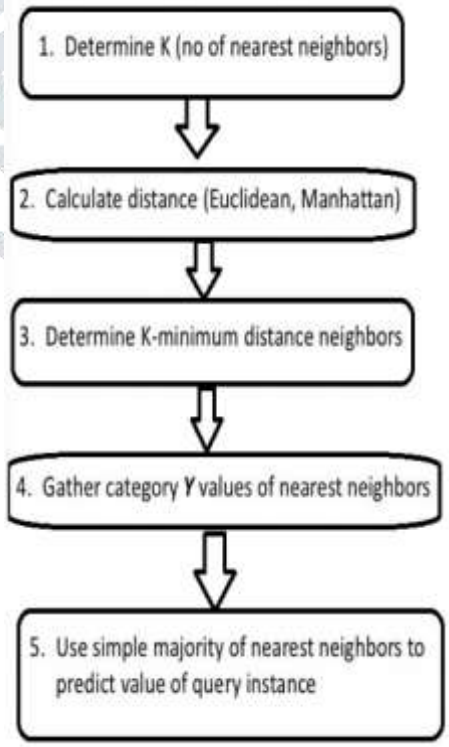

Fig -4: flow chart diagram of KNN classifier.

4. RESULTS

Method	mAP-50	Time(ms)
SSD321	45.4	61
R-FCN	51.9	85
SSD513	50.4	125
FPN FRCN	59.1	172
RetinaNet-101-500	53.1	90
RetinaNet-101-800	57.5	198
YOLOv3-416	55.3	76
YOLOv3-608	57.9	51

Table -2: result analysis table

In three classifier random forest taking a less time to obstacle detection.

5. CONCLUSIONS

Everyday life identifies the real time obstacle plays a serious role. We propose a technique for recognizing, categorizing, and localizing the image's information. In this paper we use classifiers to classifies objects: K-nearest neighbor, random forest, and decision tree. Also identify weather obstacle is static or dynamic with help above classifiers, compare the result of classifier and calculated the time of each classifier.

6. FUTURE WORK

In future use a greater number of classifiers to improve the classify the obstacle accuracy and less time taken.

7. REFERENCES

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