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Real Time Road Traffic Detection Using Computer Vision

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Abstract: *Object detection using Machine learning has achieved very good performance but there are many problems with images in real-world shooting such as noise, blurring or rotating jitter, etc. These problems effects the object detection. The main objective is to detect objects using You Only Look Once (YOLO) algorithm. The YOLO method has several advantages when compared to other object detection algorithms. In other algorithms like Convolutional Neural Network (CNN), Fast-Convolutional Neural Network the algorithm will not look at the image completely, but in YOLO, the algorithm looks the image completely by predicting the bounding boxes using convolutional network and finds class probabilities for these boxes and also detects the image faster as compared to other algorithms. We have used this algorithm for detecting different types of objects.*

Keywords: Machine Learning, Object Detection, Yolo, Convolutional Neural Network ,Fast Convolutional Neural Network

I. INTRODUCTION

The world is progressing fast enough on technology in the last years and computer science is not an area that falls behind. Computer science can be divided in many areas of study, but we could resume them in three big fields. Software development, information technology and security. We will be focusing on information technology such as artificial intelligence, machine learning and deep learning. In computer science, Artificial Intelligence (AI) is the intelligence carried out by machines. Its goal is to build smart machines capable of performing tasks that normally are made by humans.Machine learning learns patterns from the data to make the prediction more accurate. These algorithms can make relevant conclusions from the dataset by creating a mathematical function that best fits the data. Deep learning (DL) is a subset of machine learning that is formed of layers recreating the human brain. It had a breakthrough many years ago, but it came to a standstill for some years and in the last few years has had a rebound. In terms of deep learning, the structure is called artificial neural network. DL plays with parameters, it trains a network with these parameters to learn on its own. By the way, after the network has been trained it will be able to recognize patterns in the input data to make the detection accurate.

II. OBJECTIVE

The main objective of this is to learn how to detect vehicles in images. Especially, cars, motorcycles and trucks, once we have learned to detect the idea is to move it on to videos and to be able to reduce the detection time until we are simulating the detections in real time. Once the detection has been implemented and developed correctly, the final objective would be to delve into vehicle tracking to make the model count how many vehicles visualizes in the video. The first step we must focus on is to learn about the deep learning techniques used to detect objects in images. The most powerful techniques are YOLO (you only look once) and mask RCNN (recurrent convolutional neural network). For this work, we will be using YOLO as it is the best deep learning technique to detect vehicles in images and is the fastest one. Fast processing is essential to accomplish real-time detection. For this work, it is very important to train the network and to do so we will need a wide and compact dataset of vehicles. This dataset must be composed of photos of vehicles from different angles, points of view, type of light, photo quality. Once we have learnt to do the detection, we will be focusing on the tracking techniques. SORT is a tracking technique or method that will be used to count the vehicles all through the video in a precise way. Then the detection and the tracking will be joined to see how good the model is.

III. RELATED WORK

3.1 Loop Detectors and Ultrasonic sensor

These methods are used inorder to detect the vehicles. But there are some problems associated with these methods which are mentioned below

- Need to dig the roads inorder to place those loop detectors which leads to damage of roads.
- A bit expensive to install those detectors in every city.

3.2 Convolutional Neural Networks (CNN)

Convolutional neural networks are very powerful for everything that has to do with image analysis, because they can detect simple features like for example edges, lines, etc and compose in more complex characteristics until they detect what they are looking for.

3.3 Problems with Convolutional Neural Network

- Requirement of huge amount of data for training a CNN model. However, it does depend on the number of layers in the training model.
- Convolutional neural network work only on images input and do not work well with temporal sequences. You need to use Recurrent neural networks for temporal sequences.

3.4 Reginal-Convolutional Neural Network

To bypass the problem of selecting a huge number of regions, Ross Girshick et al. proposed a method where we use selective search to extract just 2000 regions from the image and he called them region proposals. Therefore, now, instead of trying to classify a huge number of regions, you can just work with 2000 regions.

3.5 Problems with R-CNN

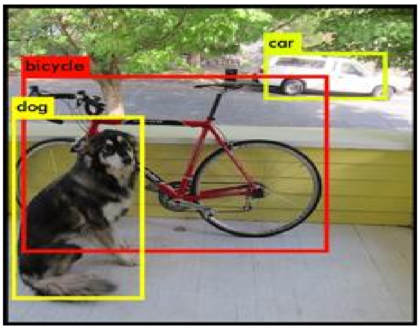
- It still takes a huge amount of time to train the network as you would have to classify 2000 region proposals per image.
- It cannot be implemented real time as it takes around 47 seconds for each test image.

IV. PROPOSED METHOD

4.1 Object-Detection With Yolo

What is YOLO?

YOLO (You Only Look Once) is a state-of-art algorithm devoted to object detection, as the name implies it can predict objects just by looking once to the image in a clever way. YOLO makes the prediction by classifying the object and locating it in the image. It uses deep learning and CNN techniques to detect objects, and distinguishes itself from its competitors because, as its name indicates, it requires to see the image only once, allowing it to be the fastest of all although it sacrifices a little accuracy. Observe the below figure on how yolo works.



YOLOV3 is the third version of the original YOLO real-time object detection model. It starts predicting the same way as the YOLOV2 model, using anchor boxes that have been created by grouping the ground-truth boxes with a K-means clustering algorithm and taking the box by the IoU between all the boxes of each group. Each bounding box is predicted by 4 coordinates.

4.2 Use of Computer Vision (OpenCV)

Computer vision is a process by which we can understand the images and videos how they are stored and how we can manipulate and retrieve data from them. Computer Vision is the base or mostly used for Artificial Intelligence. Computer-Vision is playing a major role in self-driving cars, robotics as well as in photo correction apps. OpenCV is the huge open-source library for computer vision, machine learning, and image processing and now it plays a major role in real-time operation which is very important in today's systems. By using it, one can process images and videos to identify objects, faces, or even the handwriting of a human. When it integrated with various libraries, such as Numpy, python is capable of processing the OpenCV array structure for analysis. To Identify image patterns and its various features we use vector space and perform mathematical operations on these features.

4.3 OpenCV Functionality

- Image/video I/O, processing, display (core, imgproc, highgui)
- Object/feature detection (objdetect, features2d, nonfree)
- Geometry-based monocular or stereo computer vision (calib3d, stitching, videostab)
- Computational photography (photo, video, superres)
- Machine learning & clustering (ml, flann)
- CUDA acceleration (gpu)

OpenCV is one of the most popular computer vision libraries. If you want to start your journey in the field of computer vision, then a thorough understanding of the concepts of OpenCV is of paramount importance.

V. ALGORITHM

How does YOLO-v3 Algorithm works for this example case:

STEP1: Reading input video
STEP2: Loading YOLO v3 Network.
STEP3: Reading frames in the loop
STEP4: Getting blob from the frame
STEP5: Implementing Forward Pass
STEP6: Getting Bounding Boxes
STEP7: Non-maximum Suppression
STEP8: Drawing Bounding Boxes with Labels
STEP9: Creating a new video by writing processed frames

5.1 Coco Dataset

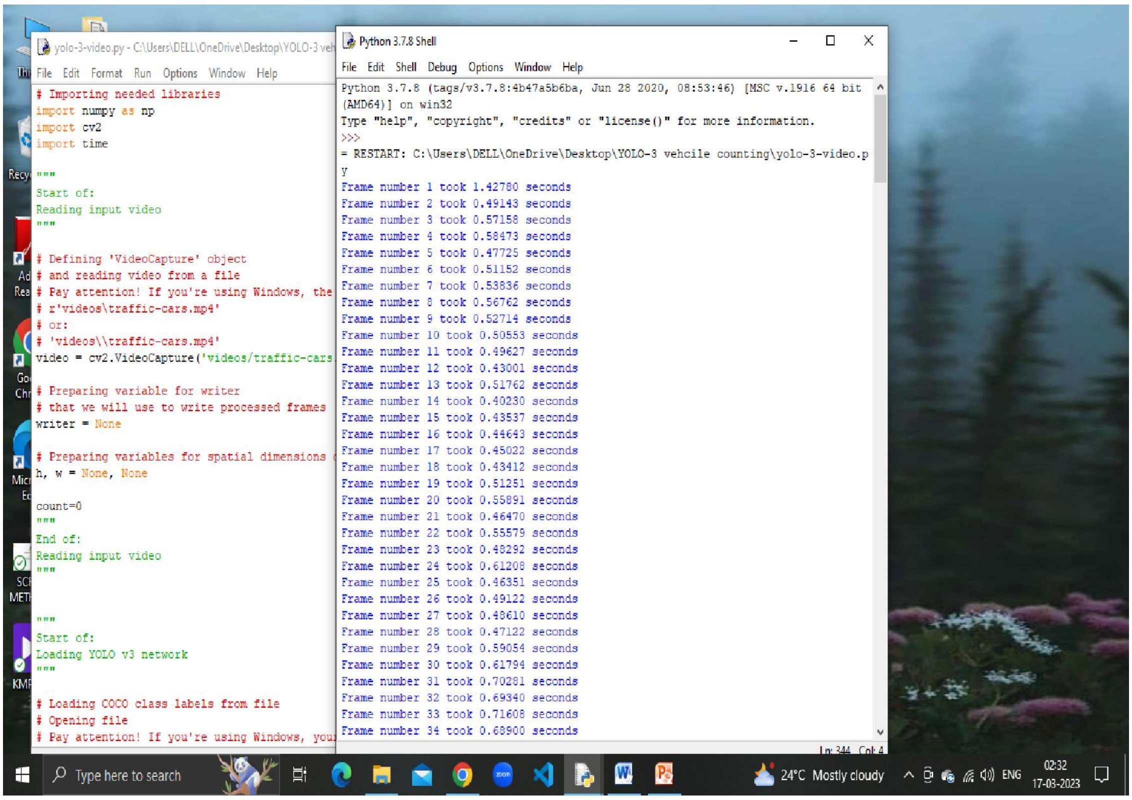
COCO (Common Objects in Context) is a large-scale object detection dataset that approaches three core analysis problems in scene recognition. Detecting non-iconic scenes of objects, contextual reasoning within objects, and accurate 2D localisation of objects. The COCO dataset consists of 80 different classes. Image-1shows the list of classes in COCO dataset. All classes are pre trained and these are stored in a list

person	bird	suitcase	fork	chair	toaster
bicycle	cat	frisbee	knife	sofa	sink
car	dog	skis	spoon	pottedplant	refrigerator
motorbike	horse	snowboard	bowl	bed	book
aeroplane	sheep	sports ball	banana	diningtable	clock
bus	cow	kite	apple	toilet	vase
train	elephant	baseball bat	sandwich	tvmonitor	scissors
truck	bear	baseball glove	orange	laptop	teddy bear
boat	zebra	skateboard	broccoli	mouse	hair drier
traffic light	giraffe	surfboard	carrot	remote	toothbrush
fire hydrant	backpack	tennis racket	hot dog	keyboard	
stop sign	umbrella	bottle	pizza	cell phone	
parking meter	handbag	wine glass	donut	microwave	
bench	tie	cup	cake	oven	

Image-1 List of classes in COCO Dataset

VI. RESULT

New video file with Detected Objects, Bounding Boxes, Labels along with probabilities and the total count of objects in our case vehicles.



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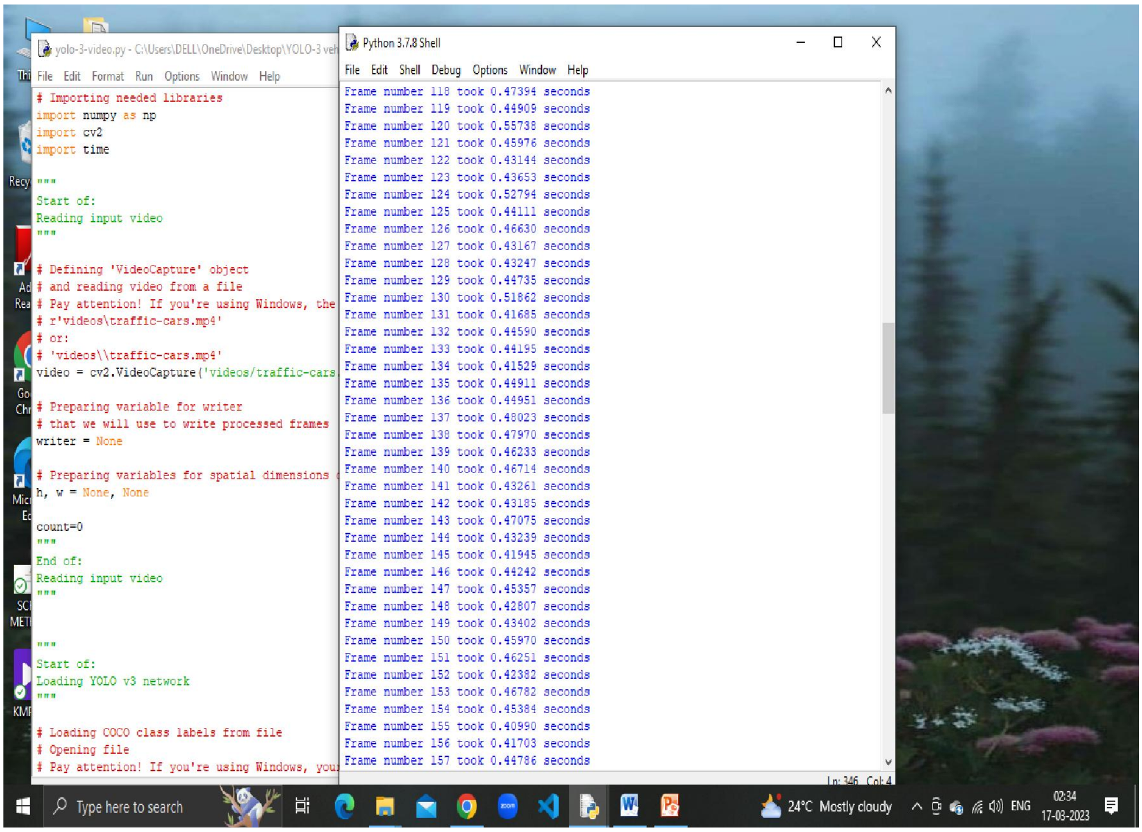
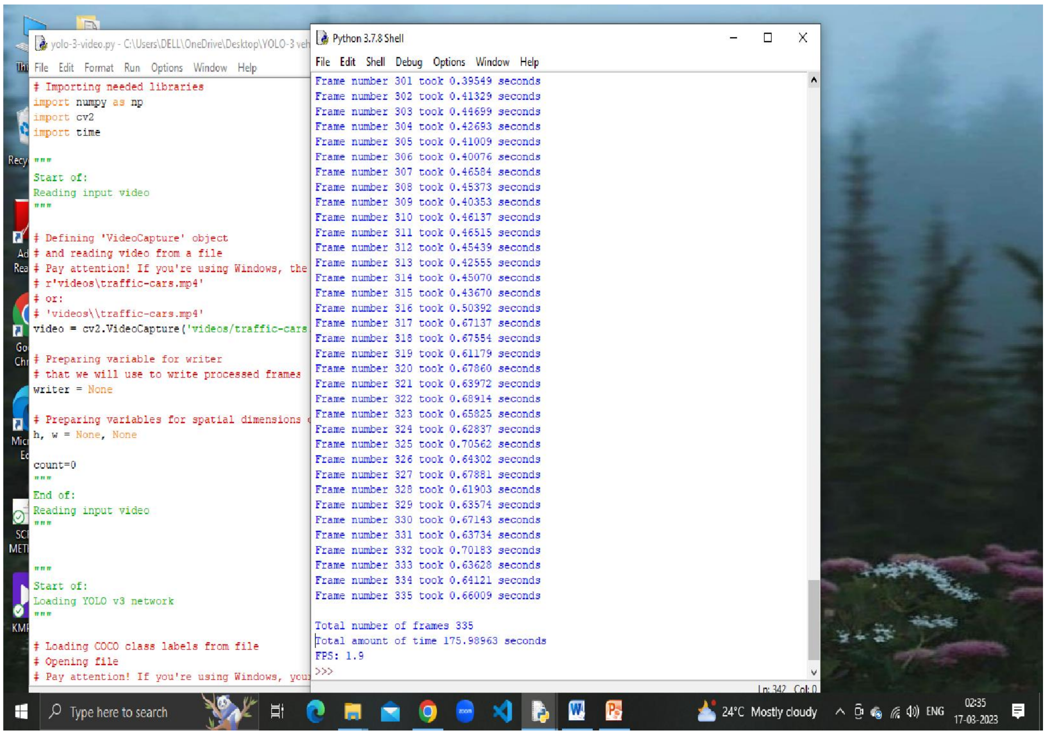

yolo-3-video.py - C:\Users\DELL\OneDrive\Desktop\YOLO-3
Python 3.7.8 Shell
File Edit Shell Debug Options Window Help
Frame number 118 took 0.47394 seconds
Frame number 119 took 0.44909 seconds
Frame number 120 took 0.55738 seconds
Frame number 121 took 0.45976 seconds
Frame number 122 took 0.43144 seconds
Frame number 123 took 0.43653 seconds
Frame number 124 took 0.52794 seconds
Frame number 125 took 0.44111 seconds
Frame number 126 took 0.46630 seconds
Frame number 127 took 0.43167 seconds
Frame number 128 took 0.43247 seconds
Frame number 129 took 0.44735 seconds
Frame number 130 took 0.51862 seconds
Frame number 131 took 0.41685 seconds
Frame number 132 took 0.44590 seconds
Frame number 133 took 0.44195 seconds
Frame number 134 took 0.41529 seconds
Frame number 135 took 0.44911 seconds
Frame number 136 took 0.44951 seconds
Frame number 137 took 0.48023 seconds
Frame number 138 took 0.47970 seconds
Frame number 139 took 0.46233 seconds
Frame number 140 took 0.46714 seconds
Frame number 141 took 0.43261 seconds
Frame number 142 took 0.43185 seconds
Frame number 143 took 0.47075 seconds
Frame number 144 took 0.43239 seconds
Frame number 145 took 0.41945 seconds
Frame number 146 took 0.44242 seconds
Frame number 147 took 0.45357 seconds
Frame number 148 took 0.42807 seconds
Frame number 149 took 0.43402 seconds
Frame number 150 took 0.45970 seconds
Frame number 151 took 0.46251 seconds
Frame number 152 took 0.42382 seconds
Frame number 153 took 0.46782 seconds
Frame number 154 took 0.45384 seconds
Frame number 155 took 0.40990 seconds
Frame number 156 took 0.41703 seconds
Frame number 157 took 0.44786 seconds
Type here to search
24°C Mostly cloudy
ENG
02:34
17-03-2023


yolo-3-video.py - C:\Users\DELL\OneDrive\Desktop\YOLO-3
Python 3.7.8 Shell
File Edit Shell Debug Options Window Help
Frame number 301 took 0.39549 seconds
Frame number 302 took 0.41329 seconds
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Frame number 304 took 0.42693 seconds
Frame number 305 took 0.41009 seconds
Frame number 306 took 0.40076 seconds
Frame number 307 took 0.46584 seconds
Frame number 308 took 0.45373 seconds
Frame number 309 took 0.40353 seconds
Frame number 310 took 0.46137 seconds
Frame number 311 took 0.46515 seconds
Frame number 312 took 0.45439 seconds
Frame number 313 took 0.42555 seconds
Frame number 314 took 0.45070 seconds
Frame number 315 took 0.43670 seconds
Frame number 316 took 0.50392 seconds
Frame number 317 took 0.67137 seconds
Frame number 318 took 0.67554 seconds
Frame number 319 took 0.61179 seconds
Frame number 320 took 0.67860 seconds
Frame number 321 took 0.63972 seconds
Frame number 322 took 0.68914 seconds
Frame number 323 took 0.65825 seconds
Frame number 324 took 0.62837 seconds
Frame number 325 took 0.70562 seconds
Frame number 326 took 0.64302 seconds
Frame number 327 took 0.67881 seconds
Frame number 328 took 0.61903 seconds
Frame number 329 took 0.63574 seconds
Frame number 330 took 0.67143 seconds
Frame number 331 took 0.63734 seconds
Frame number 332 took 0.70183 seconds
Frame number 333 took 0.63628 seconds
Frame number 334 took 0.64121 seconds
Frame number 335 took 0.66009 seconds
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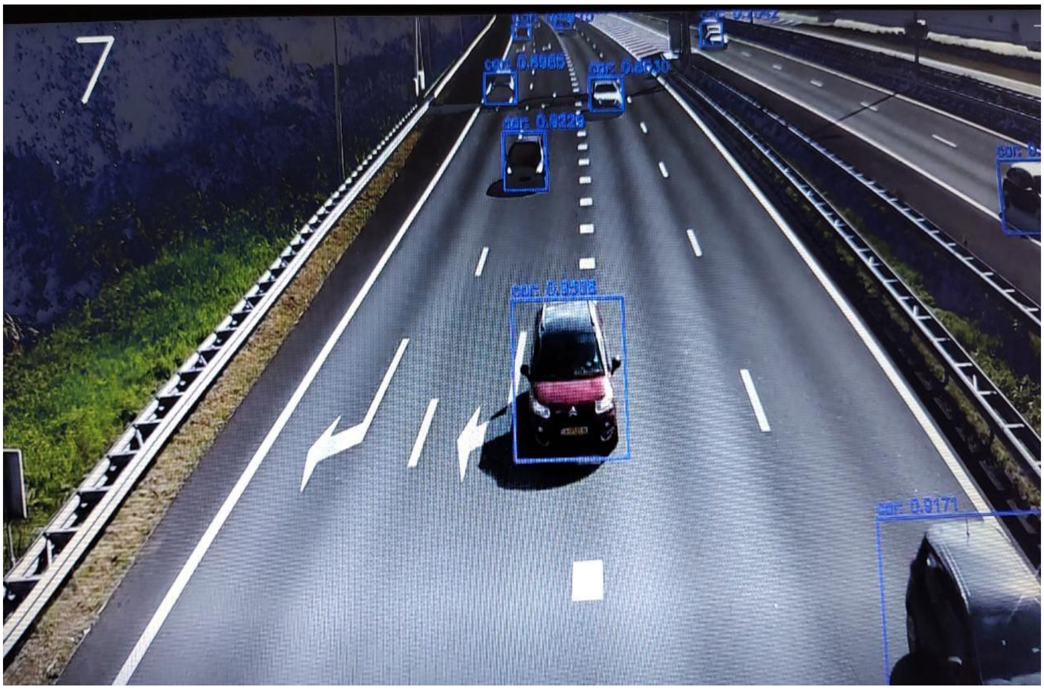
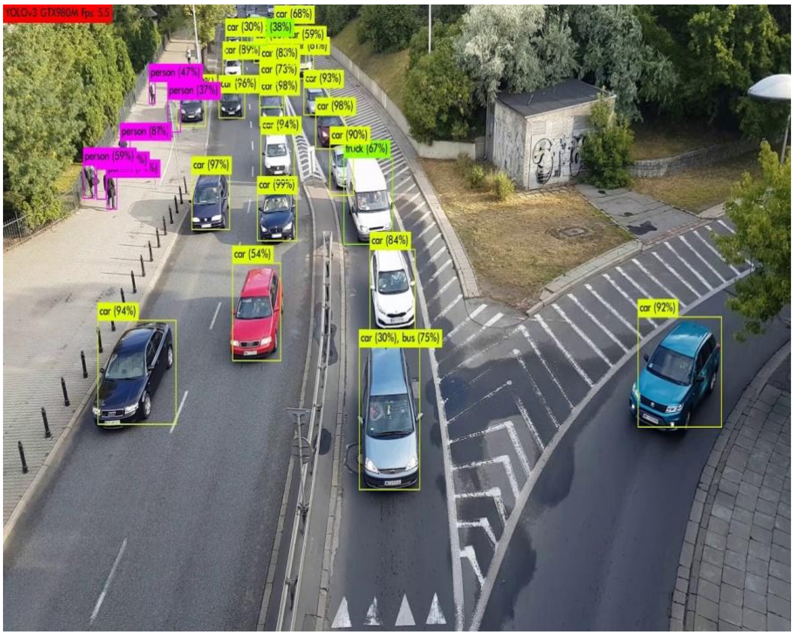
Type here to search
24°C Mostly cloudy
ENG
02:35
17-03-2023





VII. CONCLUSION

By using this thesis and based on experimental results we are able to detect object more precisely and identify the objects individually with exact location of an object in the picture in x,y axis. This paper also provide experimental results on different methods for object detection and identification and compares each method for their efficiencies.

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