ABSTRACT

Brain cancer is a rare and deadly disease with a bleak prognosis. Early detection of brain tumors is one of the most important tasks for neurologists and radiologists. Early detection of brain tumors is critical in a patient's treatment and makes it possible to save his or her life. Computer-aided diagnosis-based systems can diagnose brain tumors by using magnetic resonance imaging (MRI) as a supporting technology.

Manually detecting brain tumors from brain magnetic resonance imaging (MRI) scans can be difficult and inaccurate. Due to this, an automatic brain tumor detection and segmentation system built with some of the world's most popular deep learning-based object detection algorithms. Usage of transfer learning approaches for a deep learning model to detect malignant tumors such as glioblastoma using MRI scans. A deep learning-based approach for brain tumor identification and classification, utilizing the cutting-edge object detection framework YOLO (You Only Look Once).

Brain-Tumour-Progression dataset taken from The Cancer Imaging Archive (TCIA). The models were trained on 641 MRI scan images taken from this dataset. On this dataset, using YOLO V5, object detection algorithm, it gives the accuracy between 90 – 95%.

INTRODUCTION

Brain tumours are one of the leading causes of death and disability worldwide because they invade the most vital organ of the human body. A brain tumour is the formation of abnormal cells inside the brain. Brain cancer is currently the tenth leading cause of death from tumours in both men and women. A malignant brain tumour causes brain cancer. Brain cancer is a very serious type of cancer that occurs when cancer cells grow uncontrollably in the brain. Not all brain tumours are cancerous (cancerous). Some brain tumours are harmless (non-cancerous). Glioma and meningioma are two other names for brain cancer.

Brain tumours can be fatal, affecting patients' and their loved ones' quality of life and changing everything. The invasive properties of tumours cause a high mortality rate. However, it is encouraging that if the diagnosis is performed at an early stage, the survival rate may increase. The standard imaging technologies used in medical science to identify tumours are computed tomography (CT) scans, MRI (magnetic resonance imaging) scanning, positron emission tomography (PET), ultrasound screening, and X-ray screening.

The main disadvantages of traditional medical imaging modalities are increased cancerous risk due to high dose radiation, decreased susceptibility, high ionising with brain cells, high cost, and danger for elderly patients and pregnant women. An automatic brain tumour detection and segmentation system built with some of the most popular deep learning-based object detection algorithms in the world. A transfer learning approaches for a deep learning model to detect malignant tumours such as glioblastoma using MRI scans.

A cutting-edge object detection framework YOLO to identify and classify brain tumors using a deep learning-based approach. A transfer learning approaches for a deep learning model to detect malignant tumors such as glioblastoma using MRI scans. A deep learning-based approach for brain tumor identification and classification, utilizing the cutting-edge object detection framework YOLO (You Only Look Once). The YOLOv5 is a novel deep learning technique for object detection that requires less computational architecture than competing models.

LITERATURE SURVEY

Mohammad Tariqul Islam , et.al[1] proposed a YOLOv3 deep neural network model in a portable electromagnetic (EM) imaging system. . Fifty sample images are collected from the different head regions through the EM imaging system.The images are later augmented to generate a final image data set for training, validation, and testing, where the data set contains 1000 images, including fifty samples with a single and double tumor. 80% of the images are utilized for training the network, whereas 10% are used for validation, and the rest 10% are utilized for testing purposes.

Brain Tumor Detection Approaches: A Review using Artificial Neural Network (ANN) and Support Vector Machine (SVM) by Sethuram Rao.Grish , et.al [2]. Tumour can be detected using medical imaging techniques like Magnetic Resonance Imaging (MRI), But drawback is it cannot detect below 3 mm size. Our method can be directly integrated into state-of-the-art using YOLO, it can detect the tumour easily.

Two key problems are discovered after an intensive analysis procedure, Image Restoration and Image Enhancement. The implementation of the suggested model is applied in the Python and TensorFlow environment and Algorithms and methodologies used to solve specific research problems This examines the quantitative characteristics of brain tumors, such as shape, texture, and signal intensity, to predict high accuracy with a low error rate and the potential for future work in the field. So they proposed Brain Tumor Detection Analysis Using CNN: A Review using CNN classification technique and has been used to disregard the dataset picture algorithm error by Sunil Kumar, et.al [2].

The performance of brain tumor diagnosis and treatment using machine learning algorithms. The investigation is done against the algorithm type, dataset, the proposed model, and the performance in each of the papers by Mohammad Omid Khairandish, et.al [3] . The accuracy result among the papers studied is ranged between 79% - 97.7%. The algorithms they used are CNN, KNN, C-means, RF, respectively, ordered from the highest frequency of use to the lowest.

MRI is the most important technique, in detecting the brain tumor. A new hybrid technique based on the support vector machine (SVM) and fuzzy c-means for brain tumor classification is proposed by Parveen, et.al [5]. In this algorithm the image is enhanced using enhancement techniques such as contrast improvement, and mid-range stretch and it is like paper [2]. Double thresholding and morphological operations are used for skull striping. Fuzzy c-means (FCM) clustering is used for the segmentation of the image to detect the suspicious region in brain MRI image. Grey level run length matrix (GLRLM) is used for extraction of feature from the brain image, after which SVM technique is applied to classify the brain MRI images, which provide accurate and more effective result for classification of brain MRI images.

Mohammad Shahjahan Majib, et.al [6] proposed a “VGG-SCNet: A VGG Net-Based Deep Learning Framework for Brain Tumor Detection on MRI Images”. The segmentation, diagnosis, and isolation of contaminated tumor areas from magnetic resonance (MR) images is a prime concern. Along with these, 16 different transfer learning models were also analysed to identify the best transfer learning model to classify brain tumors based on neural networks.

A Hybrid method on brain MRI images to detect and classify the tumor has been implemented by M.O. Khairandish, et.al [7] with consideration of both CNN and SVM model advantages which is alternate approach of other [2-6], shows significant improvement

Routine blood test results are assumed to contain much more information than is usually recognised even by the most experienced clinicians. Using routine blood tests from 15,176 neurological patients we built a machine learning predictive model for the diagnosis of brain tumours. We validated the model by retrospective analysis of 68 consecutive brain tumour and 215 control patients presenting to the neurological emergency service. The sensitivity and specificity of the adapted tumour model in the validation group were 96% and 74%, respectively which is proposed by Simon Podnar, et.al [8].

PROBLEM STATEMENT

Health care sector is totally different from other industry. It is on high priority sector and people demand the best care and service regardless of cost. After the success of deep learning in other real-world applications, it is offering exciting solutions with good accuracy for medical imaging and is a key method for future applications in health sector.

Recognition of automated brain tumor in MRI is challenging due to its complex location and size variability. A state-of-the-art object detection framework YOLO (You Only Look Once)is used for identifying[fig.1] and classifying brain tumor.

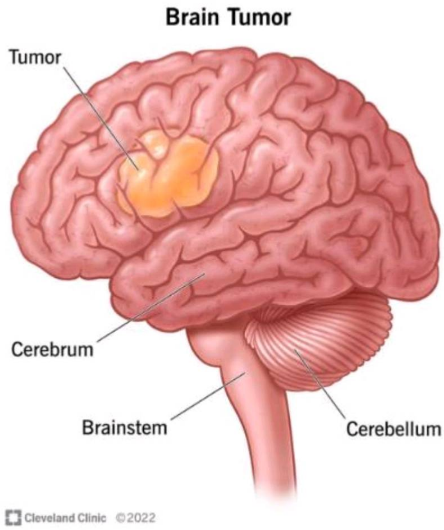

Fig.1. Brain Tumor

EXISITING SYSTEM

The multimodal features such as texture, morphological, entropy based, Scale Invariant Feature Transform (SIFT), and Elliptic Fourier Descriptors (EFDs)were extracted from brain tumor imaging database. The tumor was detected using robust machine learning techniques such as Support Vector Machine (SVM) with kernels: polynomial, Radial Base Function (RBF), Gaussian; Decision Tree (DT), Naïve Bayes, Random Forest, ANN, KNN, CNN. The method wise trends since 2012-2019 for detecting brain tumor is shown in fig.2.

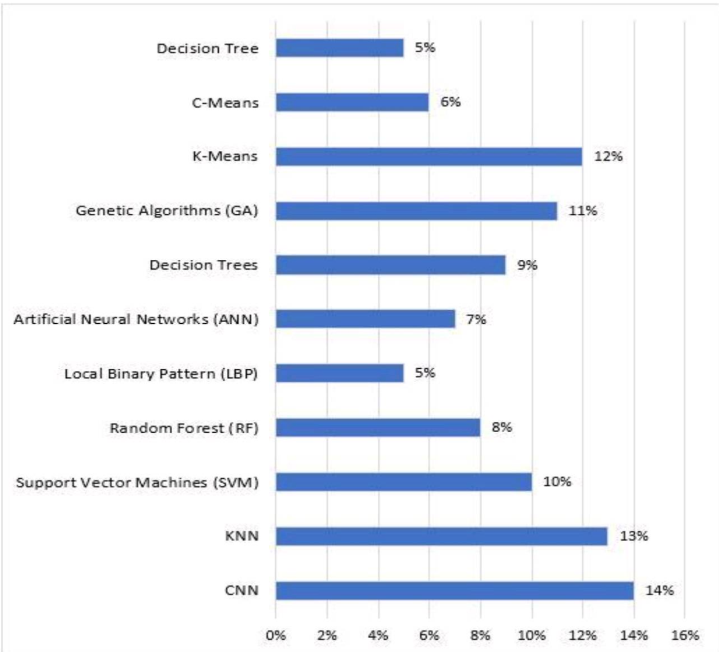

Fig.2. Method wise trends since 2012–2019

PROPOSED SYSTEM

A transfer learning approaches for a deep learning model[fig.3] is used to detect malignant tumors, such as glioblastoma, using MRI scans[fig.4]. A deep learning-based approach for brain tumor identification and classification using the state-of-the-art object detection framework YOLO (You Only Look Once). The YOLOv5 is a novel object detection deep learning technique that requires limited computational architecture than its competing models.

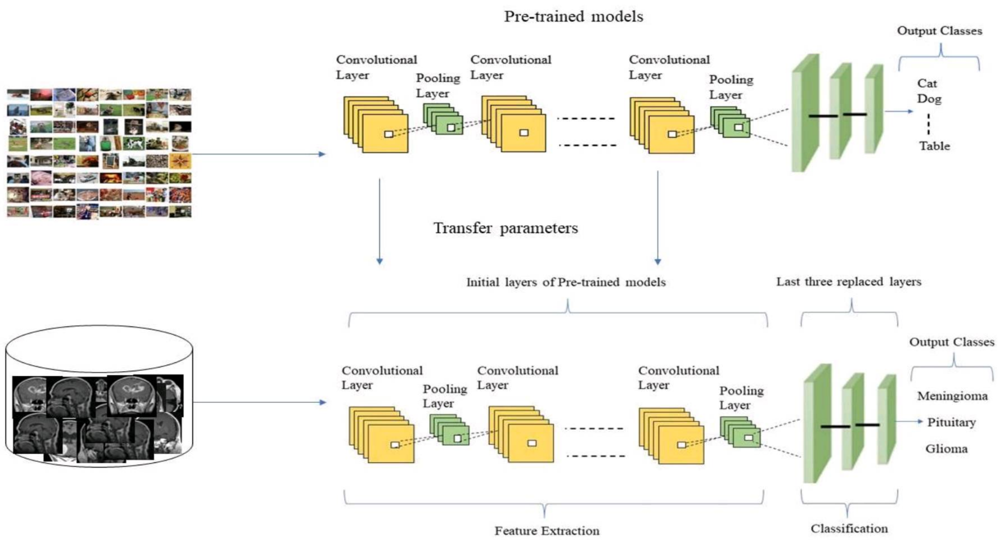

Fig.3. Transfer Learning Approach

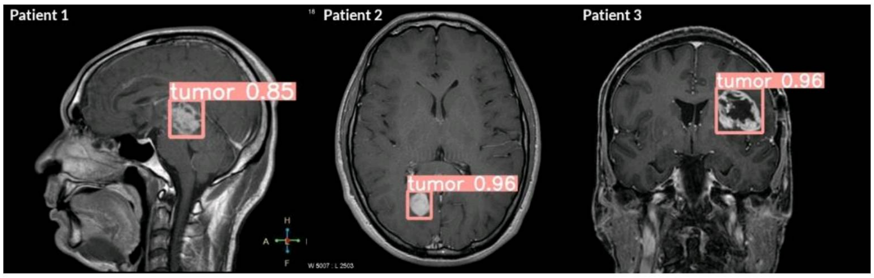

Fig.4. MRI images of Brain Tumor

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METHODOLOGY

CNN-based Object Detectors are primarily applicable for recommendation systems. YOLO (You Only Look Once) models are used for Object detection with high performance. YOLOV5 divides an image into a grid system, and each grid detects objects within itself. They can be used for real-time object detection based on the data streams. They require very few computational resources.(as shown in fig.5)

- **History of YOLO**

1. Yolo V1(Jun 8th, 2015): You Only Look Once: Unified, Real-Time Object Detection
2. Yolov2 (Dec 25th, 2016): YOLO9000:Better, Faster, Stronger
3. Yolov3 (Apr 8th, 2018): YOLOv3: An Incremental Improvement
4. Yolov4 (Apr 23rd, 2020): YOLOv4: Optimal Speed and Accuracy of Object Detection
5. Yolov5 (May 18th, 2020): YOLOv5: Optimal Speed and Accuracy of Object Detection

- **YOLO v5 Model Architecture**
  - Model Backbone
  - Model Neck
  - Model Head

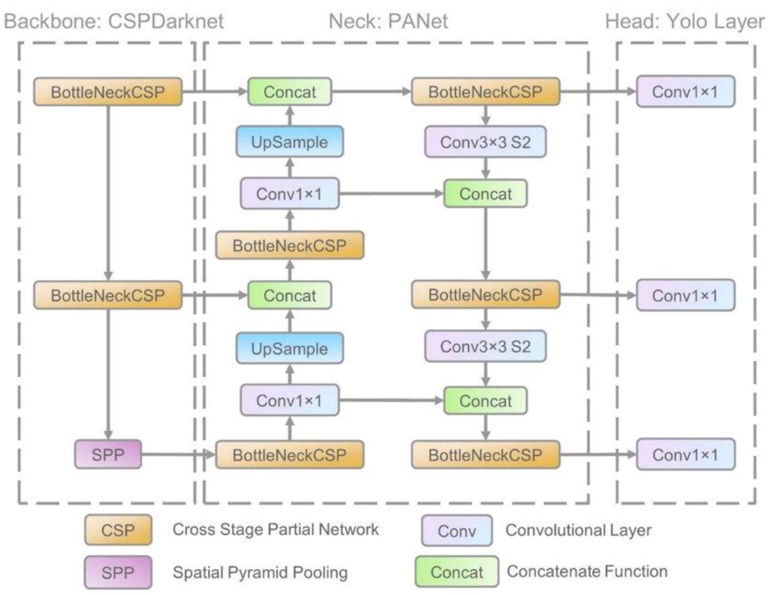

Fig.5. YOLO V5 Architecture

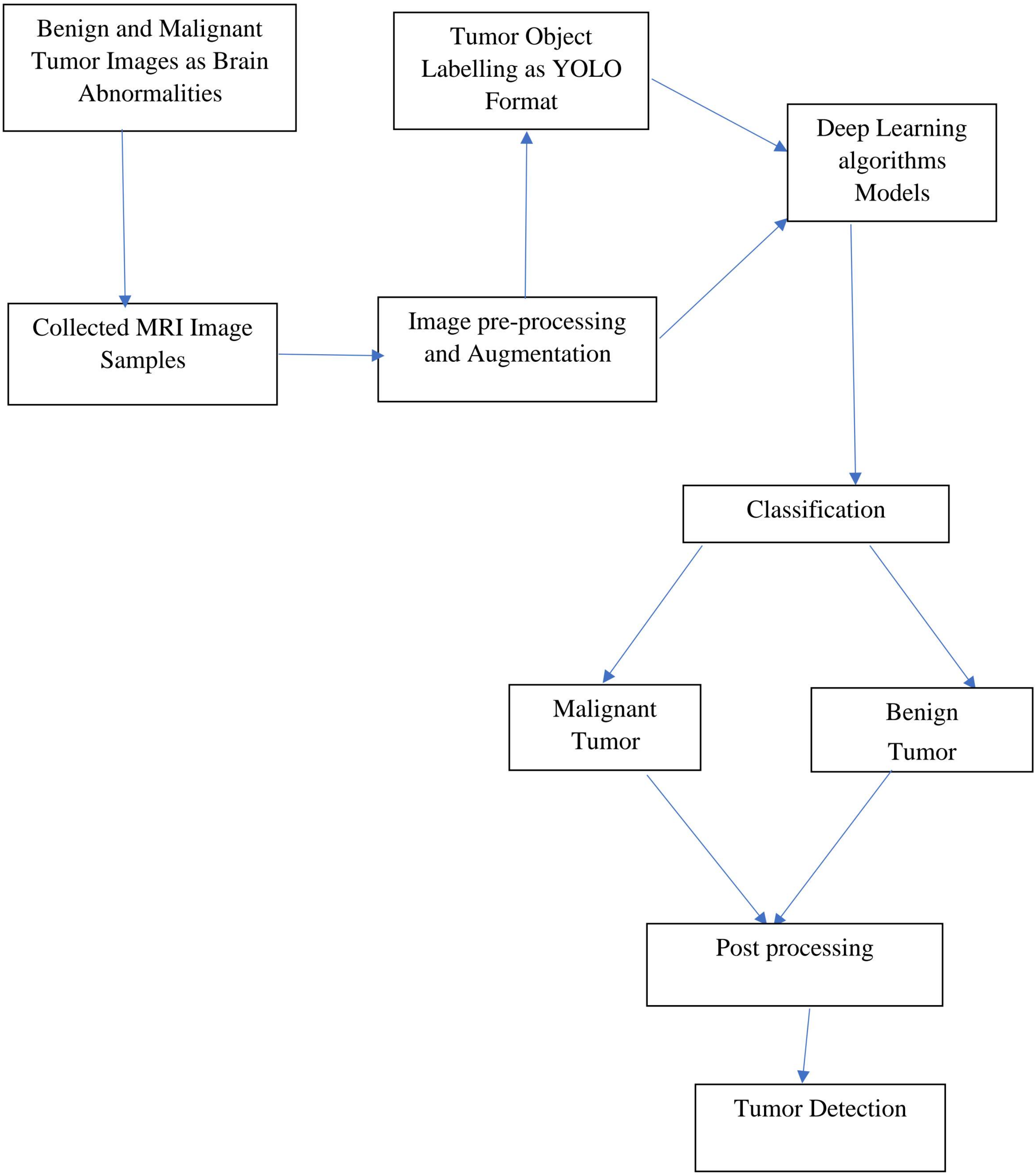

Fig.6. FLOWCHART FOR YOLOV5

WORKING OF YOLO ALGORITHM

YOLO algorithm works using the following three techniques:

- Residual blocks
- Bounding box regression
- Intersection Over Union (IOU)

Residual blocks:

First, the image is divided into various grids. Each grid has a dimension of S x S. The following image shows how an input image is divided into grids.(as shown in fig.7)

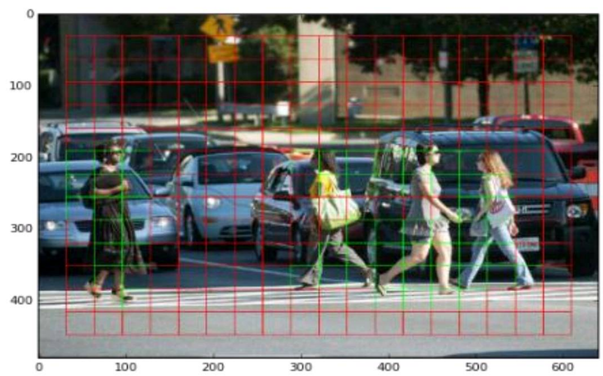

Fig.7. Residual Blocks

Bounding box regression:

A bounding box is an outline that highlights an object in an image.(as shown in fig.8)

Every bounding box in the image consists of the following attributes:

- Width (bw)
- Height (bh)
- Class
- Bounding box center (bx,by)

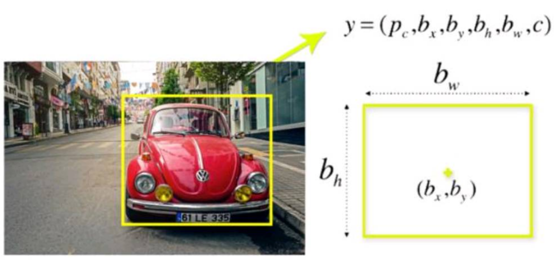

Fig.8. Bounding Box Regression

Intersection over union (IOU):

Intersection over union (IOU) is a phenomenon in object detection that describes how boxes overlap. YOLO uses IOU to provide an output box that surrounds the objects perfectly. Each grid cell is responsible for predicting the bounding boxes and their confidence scores. The IOU is equal to 1 if the predicted bounding box is the same as the real box. This mechanism eliminates bounding boxes that are not equal to the real box. The following image provides a simple example of how IOU works.

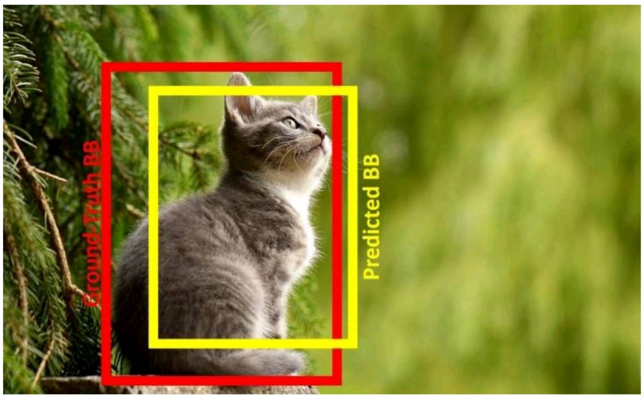

Fig.9. Intersection Over Union

In the image above, there are two bounding boxes, one in red and the other one in yellow. The yellow box is the predicted box while the red box is the real box. YOLO ensures that the two bounding boxes are equal.(as shown in fig.9)

Combination of three techniques:

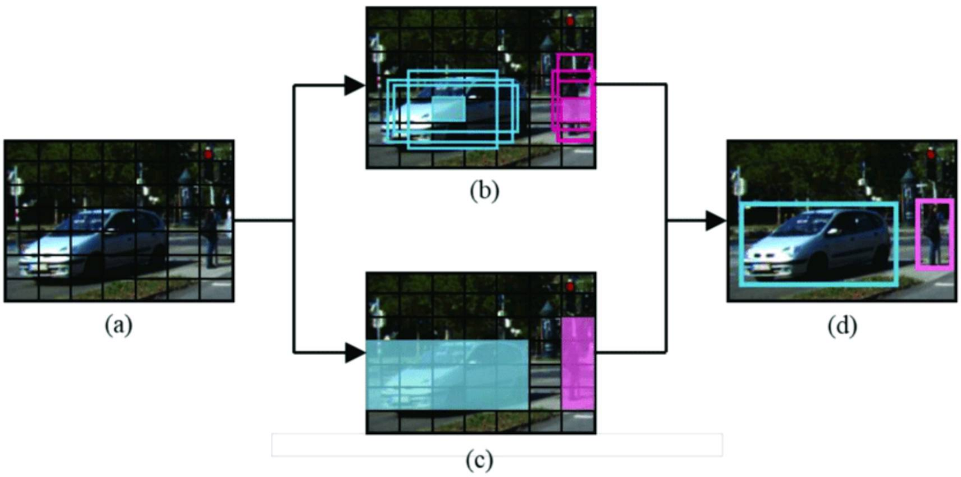

Fig.10.Comnbination of three techniques

- General Object Detector will have a backbone for pre-training it and a head to predict classes and bounding boxes. The Backbones can be running on GPU or CPU platforms. The Head can be either one-stage (e.g., YOLO, SSD, RetinaNet) for Dense prediction or two-stage (e.g., Faster R-CNN) for the Sparse prediction object detector. Recent Object detectors have some layers (Neck) to collect feature maps, and it is between the backbone and the Head.
- In YOLOv4, CSPDarknet53 is used as a backbone and SPP block for increasing the receptive field, which separates the significant features, and there is no reduction of the network operation speed. PAN is used for parameter aggregation from different backbone levels. YOLOv3 (anchor-based) head is used for YOLOv4.
- YOLOv4introduced new methods of data augmentation Mosaic and Self-Adversarial Training (SAT). Mosaic mixes four training images. Self-Adversarial Training operates in two forward and backward stages. In the 1st stage, the network alters the only image instead of the weights. In the second stage, the network is trained to detect an object on the modified image.
- Apart from the above-mentioned modules, some existing methods (Spatial Attention Module[SAM], PAN, CBN) have been modified to improve the performance.
- Yolov5 almost resembles Yolov4 with some of the following differences:
    - Yolov4 is released in the Darknet framework, which is written in C. Yolov5 is based on the PyTorch framework.(as shown in fig.11)
    - Yolov4 uses .cfg for configuration whereas Yolov5 uses .yaml file for configuration**.**

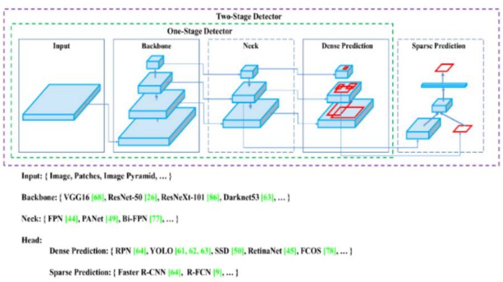

Fig.11.YOLO V5 Architecture

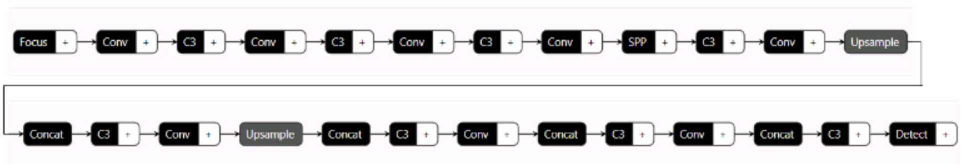

Fig.12. YOLOV5 model displayed in Netron

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