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Target Classification of Electro-optical/Infrared Image using Machine Learning Algorithm

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Abstract: ***Targets classification of electro optical/infrared images offerings a needed task for observing and surveillance of delicate areas such as military regions. Electro-optic (EO) image devices exhibit the characteristics of high determination and low noise level at day, but it do not work in dark surroundings. Infrared (IR) image devices exhibition poor determination and cannot separate target with comparable temperature. Therefore, an original context of IR image improvement depends on the evidence from EO images, which recovers the determination of IR images and benefits to differentiate objects at night. Due to the technology development there are different methods to overcome these challenges. One of the finest method is Machine Learning Technique to train the model. Convolutional neural network and mask regional based CNN algorithms are used for classification and finding the detection accuracy. In this project work data may be in the form of RGB images or binary images. It take dataset up to 100 images of each class. In that 75% of data is used for training and remaining 25% data is used for justification. This whole classification operation was done by using convolutional neural network of feature extraction layer, convolution layer, polling layer, ReLU layers. The performance of the model improved with adding of more number of layer and feature maps to the model.***

Keywords: Electro-optic, infrared, mask regional based Convolution neural network;

I. INTRODUCTION

Target classification is an important function in modern radar systems. The objective of target classification is to properly classify the targets in the image scene. Support vector machine are a popular supervised learning method that are extensively used for resolving the classification difficulties. The deep neural network has recently become a standard research theme in classification. DNNs have the capability to learn high-level representations from composite datasets, thereby, significantly advancing the state of the art in various difficulties and areas of science. These consist of record breaking in visual object classification, language understanding, speech recognition, and many others.

The convolutional neural network (CNN) has newly developed standard research topic in classification. CNNs have the capacity to study high-level representations from composite datasets, thereby, significantly advancing the state of the art in many tough problems. These contain greatest breaking in visual object classification, speech recognition, language sympathetic, and many others. CNNs have become the advanced methods for object classification in images. In a defense context, no large-scale real datasets can generally be collected. To overcome this tricky, replication methods have been established to deliver accurate images. It can change model viewpoint, object inconsistencies, scene disorder, etc., which are known to be compulsory throughout training. Thus, another plan is to train the architecture spending these replicated data, if truthful enough, and then test it on actual data. Since a high toughness is of key significance in defense requests, sectional resolutions that would be helpful to recognize and calculate may be favored, for occurrence, with separate units for finding and classification. Depending on this surveillance, it generally concentration on segmental solutions and accept that it has on condition that with a target classification algorithm, which abstracts image areas for an identification and classification stage.

Mask Recurrent Convolutional Neural Network is a deep neural network expected to resolve instance segmentation problem in machine learning or computer idea. In other words, it can isolate dissimilar objects in an image or a video. In a trained model when given an image, it provides the object bounding boxes, classes and masks.

The main challenge is to classify target in electro optical /infrared image using machine learning algorithms like mask regional based convolution neural network and calculate performance efficiency.

II. RELATED WORK

L. Wang, J. Tang and Q. Liao 2019 [1] proposed that Target class can be observed as a part of classification, which differentiates whether the signal under verified contains of an echo from a target or just resembles to the sound The deep neural network (DNN) is a standard topic for classification and has positively been applied in changed area of science

A. G. Argüello and D. Berges 2018[2], discussed a technique for categorising target within a connection depends on radar measurements. The complete processing chain establishment from raw data attainment until target grouping is explained.

Y. Kim and T. Moon 2015 [3], have indicted the use of deep convolutional neural networks (DCNNs) to identify micro-Doppler signs in spectrograms for target classification problems. Deep learning algorithms, which typically use hierarchical neural networks, have recently transformed numerous applications such as image or speech recognition.

M. Andric, Z. Durovic and B. Zrnic 2006 [4], described the automatic radar targets classification recognizes improvement of the procedure that seems to be moderately robust and for the most of accurate circumstances produces the results analogous to the human worker.

III. PROBABLE METHODOLOGY

The machine learning algorithms I taken, which are used to classify images from electro-optical / infrared sensor. The probable methodology is explained in Figure 1.

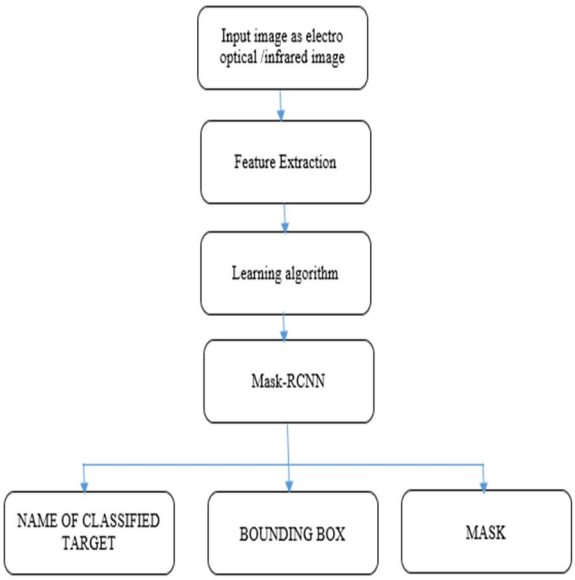

Figure 1: Probable methodology

A. Input as Images from the electro – optical / infrared Image

EO/IR (Electro-Optical/Infra-Red) systems are imaging systems used for military or law enforcement applications which include both visible and infrared sensors. Because they span both visible and infrared wavelengths, EO/IR systems provide total situational awareness both day and night and in low light conditions.

B. Data pre-processing

Data pre-processing is one of the important steps in machine learning. The raw data collected is EO/IR (Electro-Optical/Infra-Red) images. In this project work data may be in the form of RGB images or binary images. This particular package will help in splitting the data into training data and testing data. The division of the training and testing data is taken in the ratio of 0.8(80%) and 0.2 (20%) respectively from the pre-processed data.

This whole classification operation was done by using convolutional neural network of feature extraction layer, convolution layer, polling layer, ReLU layers. The performance of the model improved with adding of more number of layer and feature maps to the model.

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C. Necessary Packages to be installed for the Project

To build an ANN (Artificial Neural Network) model the necessary packages need to be installed. They are:

1) Pandas
2) Numpy
3) Matplotlib.pyplot
4) Jupyter
5) Scikit-learn

The background area is constant and hence remains unmoved and the foreground part contains moving target. Feature mining stage can be manual or automatic. As shown in Figure 1.1 the features that can be compared and measured depends on patches are occupied into account such as movement and appearance. The productivity of this step is feature representation which is the greatest significant feature of video target classification. There are three features on MRCNN those are Class of the object, Bounded Box and Semantic segmentation.

D. Mask Regional Based Convolution neural Network

Mask Recurrent Convolutional Neural Network Figure 2 is a deep neural network expected to resolve instance segmentation problem in machine learning or computer idea. In other words, it can isolate dissimilar objects in an image or a video. In a trained model when given an image, it provides the object bounding boxes, classes and masks.

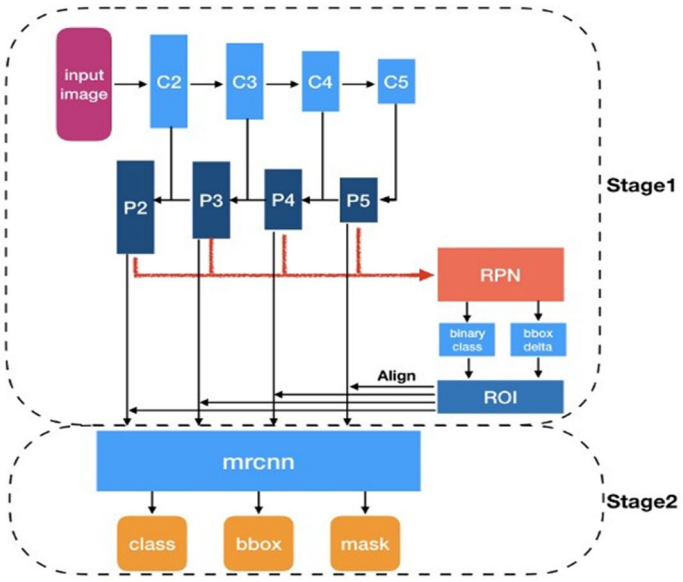

Figure 2:Mask R-CNN Structure

There are dual phases of Mask RCNN. First, it produces proposals about the areas where there might be an object based on the input image. Second, it expects the class of the object, improves the bounding box and produces a mask in pixel level of the object depends on the first stage proposal.

E. Backpropagation Algorithm

Back propagation algorithm is mainly used to train the artificial neural network in supervised machine learning. The architecture of this algorithm has three layers. The three layers are the input layer, hidden layer and the output layer. The input layer mainly helps in providing the input to the model. The hidden layer helps in calculating the weights in getting the desired output. The output layer predicts the output from the trained ANN model. The training process of the Back propagation algorithm is done in three ways.
The three steps in the training process are, the feed forward of the input training pattern, calculation the error and updating the weights to the trained model. The model is trained with more number of iterations until it gets desired output.

IV. RESULTS AND DISCUSSION

In this paper, Target classification is the identification of records opinions, events, and/or observations that deviate from the dataset's normal behavioral patterns. Target classification, also referred to as outlier detection, is used to find critical incidents, such as a technical glitch, fraud, or logistical obstacle, or potential opportunities, like in this case Target classification in electro-optical /infrared image from video Surveillance.

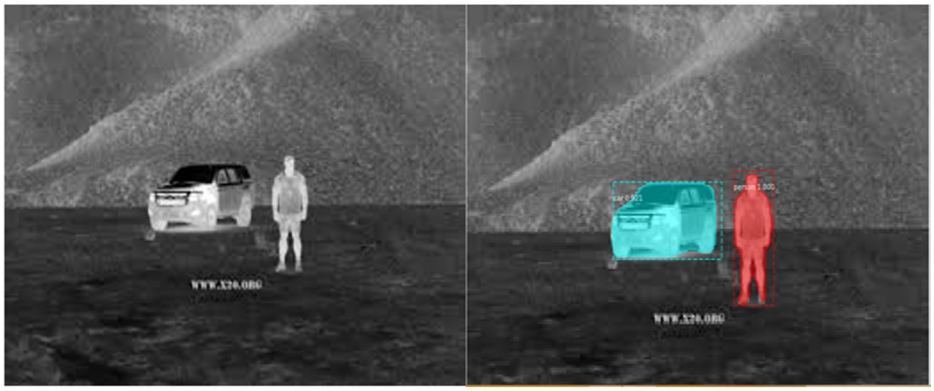

Figure 3: Detection of a person in an image; (a) Input image (b) Output image

It shows the results by classifying the target with accuracy of 99% .All the objects in an images showing correct results as person and car.

Figure 4: Detection of an abnormal object in an image; (a) Input image (b) Output image

```
Processing 1 images
image                    shape: (240, 320, 3)        min:    0.00000  max:  255.00000  uint8
molded_images            shape: (1, 1024, 1024, 3)   min: -123.70000  max:  151.10000  float64
image_metas              shape: (1, 93)              min:    0.00000  max: 1024.00000  float64
anchors                  shape: (1, 261888, 4)       min:   -0.35390  max:    1.29134  float32
```

It shows the results by classifying the target with accuracy of 90% all the objects in an images showing correct results but because of the shape of the image one of the object showing the incorrect target name.

V. CONCLUSION AND FUTURE SCOPE

This paper, mainly focuses on Target classification using machine learning algorithm. Target classification in electro optical / infrared images offering a necessary job for checking and surveillance of delicate area like military regions. To classify sensor images a feature mining process is used to distinguish a proper subspace in the unique feature space, which is depends on alteration of the unique feature. Different methods are used to perform the target classification. This method is totally based on Image Segmentation using Convolutional Neuron Network. This method greatly helps in detection of target in an image. It contains images of exercise set and validation set along with trying set data. The target classification scheme can additionally enhanced for use in particular parts as in the fields of sensor systems, interruption detection. The upcoming work can compact with Incremental learning, which supplies the current model and developed the new arriving data more competently.

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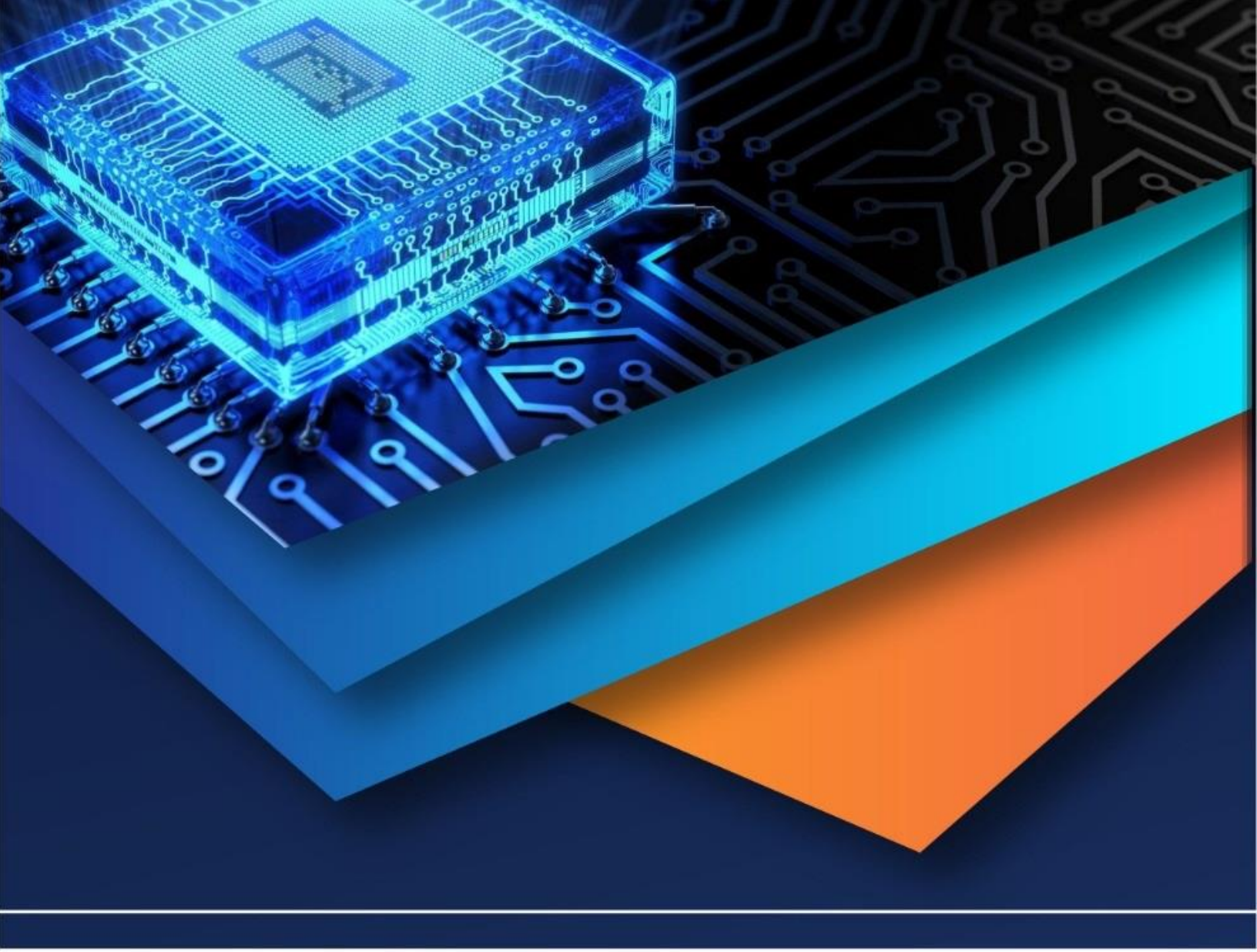

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