A Survey on Fire Detection Based on Yolo V5

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Abstract- *Fire disasters have always been a threat to homes an businesses. They cause property damage, injuries and even death. So that a system is needed to detect early fires.In this project, novel image detection which will be based on the advanced object detection like CNN model if yolov5 is proposed. The algorithm based on YOLO v5 reaches the stronger detection performance. An image based fire detection system is designed using a loptop and webcam as the main equipment. The method for using convolutional neural network to identify the fire. Which can perform object detection in real time with a good accuracy and the maximum detection speed.*

Keywords- CNN, imae, fire detection, CCTV, object detection

I. INTRODUCTION

Forest fires are wild blasts of flames that start and spread in a mass of at least half a hectare in one piece, destroying at least part of the shrubby and/or tree-covered stages (high parts). A fire is a phenomenon that is beyond the control of humans, both in duration and in extent. Knowledge of the origins of fires is the foundation of any effective prevention policy. Indeed, when the causes of fire are known, it is then easier to eradicate them through the implementation of concrete actions, and therefore to limit the number of fires
.

Fires can have a significant impact on public safety, and every year, they cause a high number of deaths, injuries, and property damage.The timely detection of fires can dramatically reduce casualties and losses.

Every year, between 60 and 80 thousand wildfires occur and destroy 3 to 10 million miles of land. Forest fires have different environmental impacts depending on their importance, and their frequency causes may also be diverse. Fires influence biological diversity in many ways.

Forest fires create more damage and increase the expense of fire suppression if they are not put out quickly enough. The time spent between fire discovery and warning the relevant authorities is the most important aspect that could lessen wildfire dangers. Currently, several terrestrial and spatial technologies are used to help official authorities in identifying wildfires at their early stages and the localization of their area. However, these technologies have several drawbacks that may restrict their ability to detect fires.

Furthermore, we need to develop new tools for monitoring wildfires and improve our fire control strategies to reduce the destruction of our forests and their riches. Recent advances in artificial intelligence and machine learning have increased the success of image-based modeling and analysis in a variety of applications. In addition, machine learning is utilized in a variety of computer vision tasks, image classification, object detection, semantic segmentation, and a variety of other applications.

Traditional fire-detection methods mainly use smoke and temperature sensors with a limited detection range, scenarios, and extended response times. With the developments in the areas of artificial intelligence and machine learning, fire detection based on deep learning is extensively used. However, fire-detection scenarios are often too complex and changeable.

II. EXISTING SYSTEM

The existing system for detecting fire are smoke alarms and heat alarms. The main disadvantage of the smoke sensor alarm and heat sensor alarms are that just one module is not enough to monitor all the potential fire prone places. The only way to prevent a fire is to be cautious al the time. Even if they are installed in every nook and corner, it just is not sufficient for an efficient output consistently. As the number of smoke sensor requirement increase the cost will also increase to its multiple. The proposed system can produce consistent and highly accurate alerts within seconds of accident of the fire. It reduces cost because only one software is enough to power the entire network of surveillance. Research is active on this field by data scientists and machine learning researchers. The real challenge is to minimize the error in detection of fire. The existing system having the disadvantages are,

- This method is well suited only when the fire is clearly visible. If the fire is far away from the camera and covered with dense smoke, this method performs poorly

- Sensitive to dust particles and insects, meaning that regular maintenance is needed.
- Some techniques require more current to operate (they are typically wired to a 110-volt power source)
- The system is essentially useless if the batteries aren't charged, since it won't work properly.
- When RGB model using, any object presented in red color it will send the alerts.
- High execution time

III. PROPOSED FRAMEWORK

One of the most expensive and fatal natural disasters in the world is forest fires. For this reason, early discovery of forest fires helps minimize mortality and harm to ecosystems and forest life. Fire-detection technology is of great importance for successful fire-prevention measures. Image-based fire detection is one effective method. At present, object-detection algorithms are deficient in performing detection speed and accuracy tasks when they are applied in complex fire scenarios.

The proposed architecture combines the YOLO architecture with two weights with a voting ensemble CNN architecture. One of the most popular algorithms for object detection with the name YOLO.YOLO is an acronym for "You Only Look Once" and it has that name because this is a real-time object detection algorithm that processes images very fast. In YOLO, a single neural network is applied to the full image. The images are divided into regions and prediction boxes with the help of network for region. Prediction probabilities weights bounding boxes. The pipeline works in two stages. If the CNN detects the existence of abnormality in the frame, then the YOLO architecture localizes the smoke or fire. The addressed tasks are classification and detection in the presented method. The obtained model's weights achieve very decent results during training and testing.

This project presents three applications based on the FLAME dataset that utilize deep learning solutions to address challenges related to fire detection. The first application in-volves the classification of fire versus non-fire using a convolutional neural network (CNN) approach. The second application involves the detection of fire, which can be used for real-time monitoring and data labeling. The third application involves fire segmentation, which can be used to identify fire zones in video frames marked as containing fire in the first application.

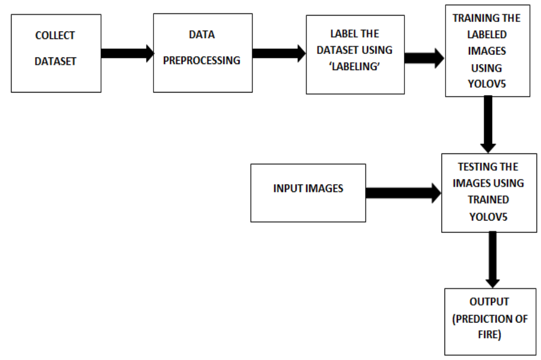

Fig1.Block diagram

IV. METHODOLOGY

In this paper, the proposed methodology consists of different stages. The stages include *A. collect Dataset, B. Data Preprocessing, C. label the dataset, D. training the labeled images using yolo v5, E.test the images,F.prediction of fire.*

A.Collect dataset

Collections in Python are containers used for storing data. Python has a built-in collections module providing additional data structures for collections of data. Sets are used to store multiple items in a single variable. Here dataset are collected in the form of images.

Fig 2.Example of dataset

B.Data preprocessing

Data preprocessing is a process which convert raw data into a clean data set, which means we must convert the data set to numeric data. real-world data in the form of text, images, video, etc., is messy. Not only may it contain errors and inconsistencies, but it is often incomplete, and doesn't have a regular, uniform design.

Steps involved in data preprocessing

1)Data quality assessment
2)Data cleaning
3)Data transformation
4)Data reduction

1)Data Quality Assessment

Take a good look at your data and get an idea of its overall quality, relevance to your project, and consistency.

2)Data Cleaning

Data cleaning is the process of adding missing data and correcting, repairing, or removing incorrect or irrelevant data from a data set. Dating cleaning is the most important step of preprocessing because it will ensure that your data is ready to go for your downstream needs. Data cleaning will correct all of the inconsistent data you uncovered in your data quality assessment.

3)Data Transformation

With data cleaning, we've already begun to modify our data, but data transformation will begin the process of turning the data into the proper format(s) you'll need for analysis and other downstream processes.

4)Data Reduction

The more data you're working with, the harder it will be to analyze, even after cleaning and transforming it. Depending on your task at hand, you may actually have more data than you need. Especially when working with text analysis, much of regular human speech is superfluous or irrelevant to the needs of the researcher. Data reduction not only makes the analysis easier and more accurate, but cuts down on data storage.

C.Label the dataset using 'labeling'

Data labeling is the process of identifying raw data (images, text files, videos, etc.) and adding one or more meaningful and informative labels to provide context so that a machine learning model can learn from it. Here the dataset are labelled as fire and no fire.

D.Training the labeled images using yolov5

Once the labeling is done, we will split our data into training and validation sets. Training process is done by labelling the images using Yolov5.

E.Testing the images using trained yolov5

Input images is given to the system to identify whether fire is detected.Testing process is done after input image is given. This process is done by testing the image whether fire is detected. If fire is detected, it gives an alert message.

F.Prediction of fire

The fire detection results were fairly good even though the model was trained only for a few epochs.

V.ARCHITECTURE OF YOLOv5

Object detection, a use case for which YOLOv5 is designed, involves creating features from input images. These features are then fed through a prediction system to draw boxes around objects and predict their classes.

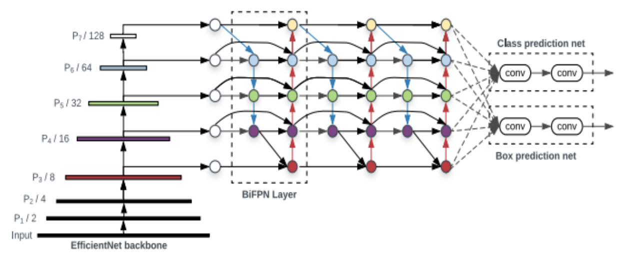

Fig 3.architecture of yolov5

The YOLO model was the first object detector to connect the procedure of predicting bounding boxes with class labels in an end to end differentiable network.

The YOLO network consists of three main pieces.

A)*Backbone:*

A convolutional neural network that aggregates and forms image features at different granularities.

B)Neck:

A series of layers to mix and combine image features to pass them forward to prediction.

C)Head:

Consumes features from the neck and takes box and class prediction steps.

The contributions of YOLOv4 and YOLOv5 are foremost to integrate breakthroughs in other areas of computer vision and prove that as a collection, they improve YOLO object detection

.

D)Training Procedure

The procedures taken to train a model are just as important as any factor to the end performance of an object detection system, although they are often less discussed.

E)Data Augmentation:

Data augmentation makes transformations to the base training data to expose the model to a wider range of semantic variation than the training set in isolation.

VI. EXPERIMENTATION RESULTS

Many of the large fires that occur globally have evolved from small forest fires. In addition, since forest fires are dynamic targets, it is impossible to have good performance using conventional target detection models.

Therefore, it is important to study how to detect initial forest fires and small-target forest fires. To address these problems, a small-target forest fire detection model is proposed in this paper. In summary, this paper proposes a YOLOv5 algorithm for fire detection in complex scenarios, achieving a balanceefficiency and performance.

(a)Fire:86%,Normal:14%SSDmethod

(b)Fire:83%,Normal:17%Faster R-CNN method

(c)Fire:92%,Normal:8% YOLOv5 method

FIGURE (a) shows the output of SSD method which has an accuracy of 86%.
FIGURE (b) shows the output of Faster RCNN method which has an accuracy of 83%.
FIGURE (c) shows the output of YOLOV5 method which has the highest accuracy of 92%.

VII. CONCLUSION

In this project, YOLOv5 was proposed to detect fire in conflagration accident. An image based fire detection system is designed using a laptop and webcam as the main equipment. The method for using convolutional neural network to identify the fire.Which can perform object detection in real time with a good accuracy and the maximum detection speed. The further work is to continue to improve the network and design the hardware in combination with related topics.

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