DETECTING FIRE COMBUSTION IN FORESTS USING IBM WATSON STUDIO

Mini Project Report

Submitted By **(BATCH NO: CSE_07)**

V.SANGEETHA	**18UK1A05B9**
KANCHA DHEERAJ	**18UK1A0578**
POLSANI RUCHITHANJALI	**18UK1A0596**
DEEKSHA KOMATI	**18UK1A05D0**

ABSTRACT

Forest fires represent a real threat to human lives, ecological systems, and infrastructure. Many commercial fire detection sensor systems exist, but all of them are difficult to apply at large open spaces like forests because of their response delay, necessary maintenance needed, high cost, and other problems. In this paper a forest fire detection algorithm is proposed, and it consists of the following stages. Firstly, background subtraction is applied to movement containing region detection. Secondly, converting the segmented moving regions from RGB to YCbCr color space and applying five fire detection rules for separating candidate fire pixels were undertaken. Finally, temporal variation is then employed to differentiate between fire and fire-color objects. The proposed method is tested using data set consisting of 6 videos collected from Internet. The final results show that the proposed method achieves up to 96.63% of true detection rates. These results indicate that the proposed method is accurate and can be used in automatic forest fire-alarm systems.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW:

Forest fires are a major environmental issue, creating economic and ecological damage while endangering human lives. There are typically about 100,000 wildfires in the United States every year. Over 9 million acres of land have been destroyed due to treacherous wildfires. It is difficult to predict and detect Forest Fire in a sparsely populated forest area and it is more difficult if the prediction is done using ground-based methods like Camera or VideoBased approach. Satellites can be an important source of data prior to and also during the Fire due to its reliability and efficiency. The various real-time forest fire detection and prediction approaches, with the goal of informing the local fire authorities.

1.2 PURPOSE:

The purpose of this project is to predict the detecting fire combustion in forest by this we can be capable to predict the fire combustion in forests.

CHAPTER 2
LITERATURE SURVEY

2.1 EXISTING PROBLEM:

The problem with forest fires is that the forests are usually remote, abandoned/unmanaged areas filled with trees, dry and parching wood, leaves, and so forth that act as a fuel source. These elements form a highly combustible material and represent the perfect context for initial-fire ignition and act as fuel for later stages of the fire. The fire ignition may be caused through human actions like smoking or barbeque parties or by natural reasons such as high temperature in a hot summer day or a broken glass working as a collective lens focusing the sun light on a small spot for a length of time thus leading to fire-ignition. The initial stage of ignition is normally referred to as “surface fire” stage. This may then lead to feeding on adjoining trees and the fire flame becomes higher and higher, thus becoming “crown fire.” Mostly, at this stage, the fire becomes uncontrollable and damage to the landscape may become excessive and could last for a very long time depending on prevailing weather conditions and the terrain.

Millions of hectares of forest are destroyed by fire every year. Areas destroyed by these fires are large and produce more carbon monoxide than the overall automobile traffic. Monitoring of the potential risk areas and an early detection of fire can significantly shorten the reaction time and also reduce the potential damage as well as the cost of fire fighting. The objective is to detect the fire as fast as possible and its exact localization and early notification to the fire units is vital. This is the deficiency that the present Invention attempts to remedy, by means of detection of a forest fire at the very early stage, so as to enhance or ensure the chance to put it out before it has grown beyond control or causes any significant damage.

2.2 PROPOSED SOLUTION:

The DEEP's Forest Fire Control Office urges all who enjoy the use of Connecticut's parks, forests and open spaces, to use fires with caution and heed the following recommendations especially during forest fire season:

Obey local laws regarding open fires, including campfires;

Keep all flammable objects away from fire;

Have firefighting tools nearby and handy;

Carefully dispose of hot charcoal;

Drown all fires;

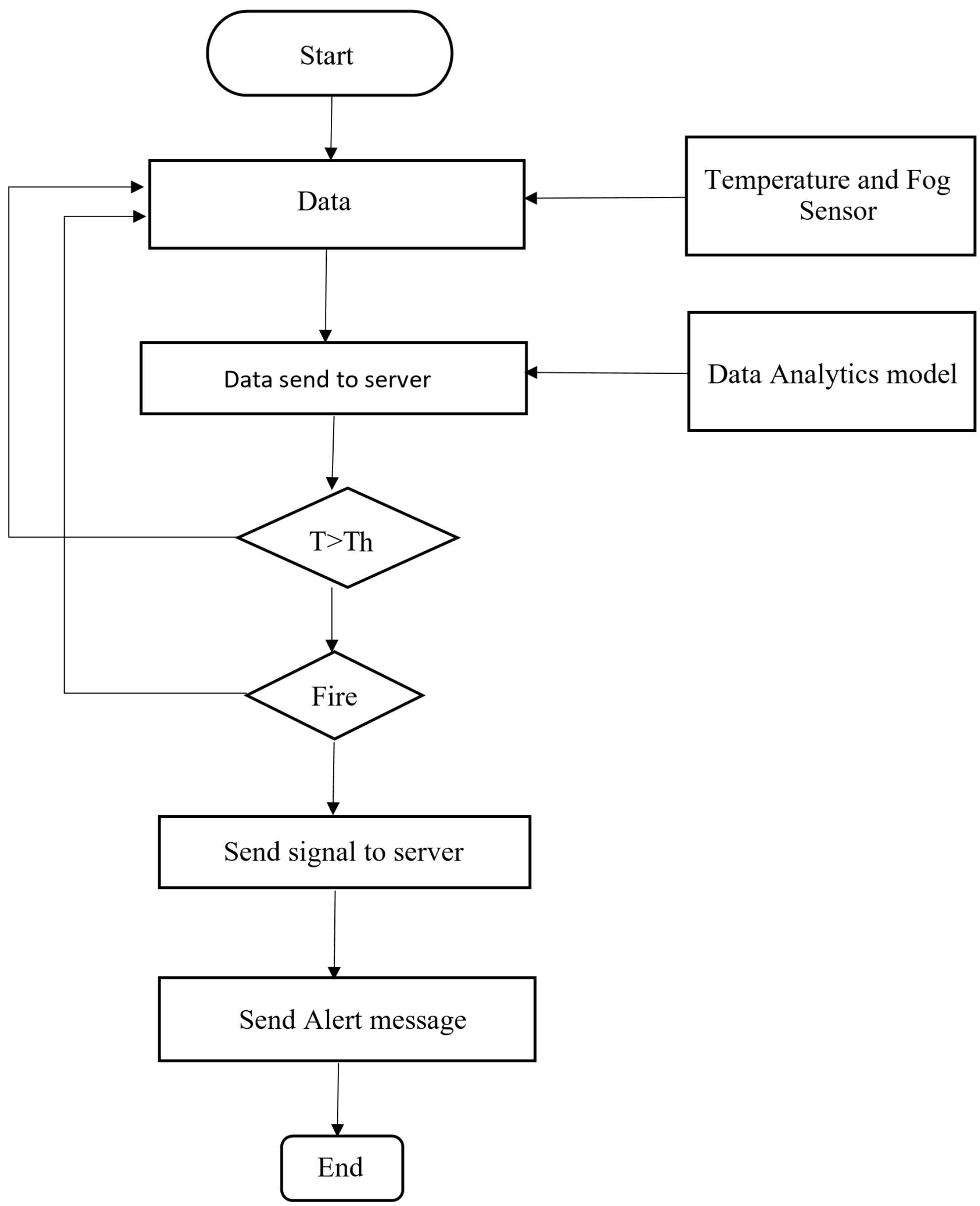
Carefully extinguish smoking mat

CHAPTER 3

THEORITICAL ANALYSIS

3.1 BLOCK DIAGRAM:

Once the input image from the video frame is sent to the model, if the fire is detected it is showcased on the console, and alerting sound will be generated and an alert message will be sent to the Authorities.



3.2 HARDWARE/SOFTWARE DESIGNING:

To complete this project you should have the following software and packages

Anaconda Navigator :

Anaconda Navigator is a free and open-source distribution of the Python and R programming languages for data science and machine learning related applications. It can be installed on Windows, Linux, and macOS.Conda is an open-source, cross-platform, package management system. Anaconda comes with so very nice tools like JupyterLab, Jupyter Notebook, QtConsole, Spyder, Glueviz, Orange, Rstudio, Visual Studio Code. For this project, we will be using Jupiter notebook and spyder

To build Deep learning models you must require the following packages:

Tensor flow:

TensorFlow is an end-to-end open-source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries, and community resources that lets researchers push the state-of-the-art in ML and developers can easily build and deploy MLpowered applications.

Keras:

Keras leverages various optimization techniques to make high-level neural network API easier and more performant. It supports the following features:

1. Consistent, simple, and extensible API.
2. Minimal structure - easy to achieve the result without any frills.
3. It supports multiple platforms and backends.
4. It is a user-friendly framework that runs on both CPU and GPU.
5. Highly scalability of computation.

open cv:

OpenCV is a library of programming functions mainly aimed at real-time computer vision

6. Type “pip install numpy” and click enter. • Type “pip install pandas” and click enter.
7. Type “pip install matplotlib” and click enter.
8. Type “pip install scikit-learn” and click enter. • Type "pip install tensorflow==1.14.0” and click enter.
9. Type "pip install keras=2.2.4” and click enter.
10. Type "pip install opencv-python” and click enter.
11. Type “pip install Flask” and click enter.

CHAPTER 4 EXPERIMENTAL INVESTIGATIONS

Application of 3S and Integration Technology:

The development and direction of firefighting work in various nations are moving toward 3S technology, which relies on digitizing forestry data, integrating forest fire warning, and monitoring system applications, and building automated, intelligent, and networked digital forest fire management systems. Forest fire research in Taiwan has also widely used 3S technology. In a study by Hsieh et al. (2011), detection technique changes were used to explore the use of high-resolution value aerial images on automated forest fire mapping. Liu (2004) integrated GIS and MODIS images for application to forest fire detection research. Chung and Chen (2002) integrated National Oceanic and Atmospheric Administration (NOAA) - Advanced Very High Resolution Radiometer (AVHRR) imaging with GIS to conduct forest fire monitoring research. These studies have all been centered around 3S technology for exploring forest fire warning and monitoring systems.

Forest Fire Prediction:

Forest fires prediction combines weather factors, terrain, dryness of flammable items, types of flammable items, and ignition sources to analyze and predict the combustion risks of flammable items in the forest. Forest fire prediction has developed rapidly in various countries in the world since its inception in the 1920s. Hsiao also considered space and time variations in weather factors, used GIS systems to conduct temperature and rainfall space-time estimates, and estimated forest fire hazard rating predictions for forests in Taiwan on a given day.

Forest Fire Management Policy and Promotion Research:

Fire prevention and control must first consider human factors. Forest–protection policy is an essential part of social policy, and modern forestry is gradually shifting its focus to public fireprevention education. Hong (2005) explored the relationship between forest fire prevention and fire-prevention promotion using the Dapu utility district in the Chiayi forest area, determined the optimal fire prevention promotional method, and established the optimal fire prevention promotion model. The research results indicated that the public perceived that rainfall and agricultural burning were the most influential factors that contributed to forest fires. People's perception of forest fire prevention and fighting importarson penalties, updating fire fighting tools, burned forest, and reducing forest losses factors. Fire prevention promotion satisfaction levels were the highest in the television, poster, t-shirt, and fireprevention drill factors. The surveyed people believed that the possession of fireprevention knowledge by promotional personnel, the reporting of arsonists, and the cultivation of the love of forests were essential to promoting successful fire prevention. Legislation is one form of valuing forest fire prevention work. The use of policy and legislation to formulate suitable forest fire-prevention and fighting systems is a crucial topic. According to the Disaster Prevention and Protection Act, Article 3, Paragraph 6, the Council of Agriculture in the Executive Yuan is the central disaster prevention and response competent authority for forest fires, and the authority responsible for forests in Taiwan is the Forestry Bureau. Therefore, the prevention and fighting of forest fires are the primary functions of the Forestry Bureau. The complexity of forest fires also increases the difficulty of forest fire prevention. Thus, referencing the policies of advanced countries to search for an effective forest fire fighting strategy that is suitable to Taiwan to reduce losses is an urgent matter. Policy assessments assist the formulation, implementation, and feasibility of policies and programs, and allow resources to be saved to achieve maximum effectiveness. At the same time, the adoption of assessment rapidly allows expected goals to be achieved. Assessment results serve as a reference for revising programs and monitoring implementation personnel.

Postfire Research:

Forest fires consume forestry resources, and influence trees, vegetation, forest animals and plants, soil, and microbial growth. Forest fires also endanger the life and property of local residents. Fires also adversely influence the ecological system, and can damage ecological balance and cause the degradation of forest communities. Forest fires also cause air pollution. Assessments of fires must consider both economic loss and ecological effects. The assessment of forest fire damage and disaster levels must be objective.

Hsieh primarily used satellite images in coordination with GIS to accurately calculate information related to the damaged area, the extent and scale of damages, and routes. Hsieh then considered historic forest fire cases, damage data, and causes of fires determined by previous researchers, natural factors (climate, humidity, and wind direction) to explore and assess the feasibility of building an estimation system.

Research Cooperation:

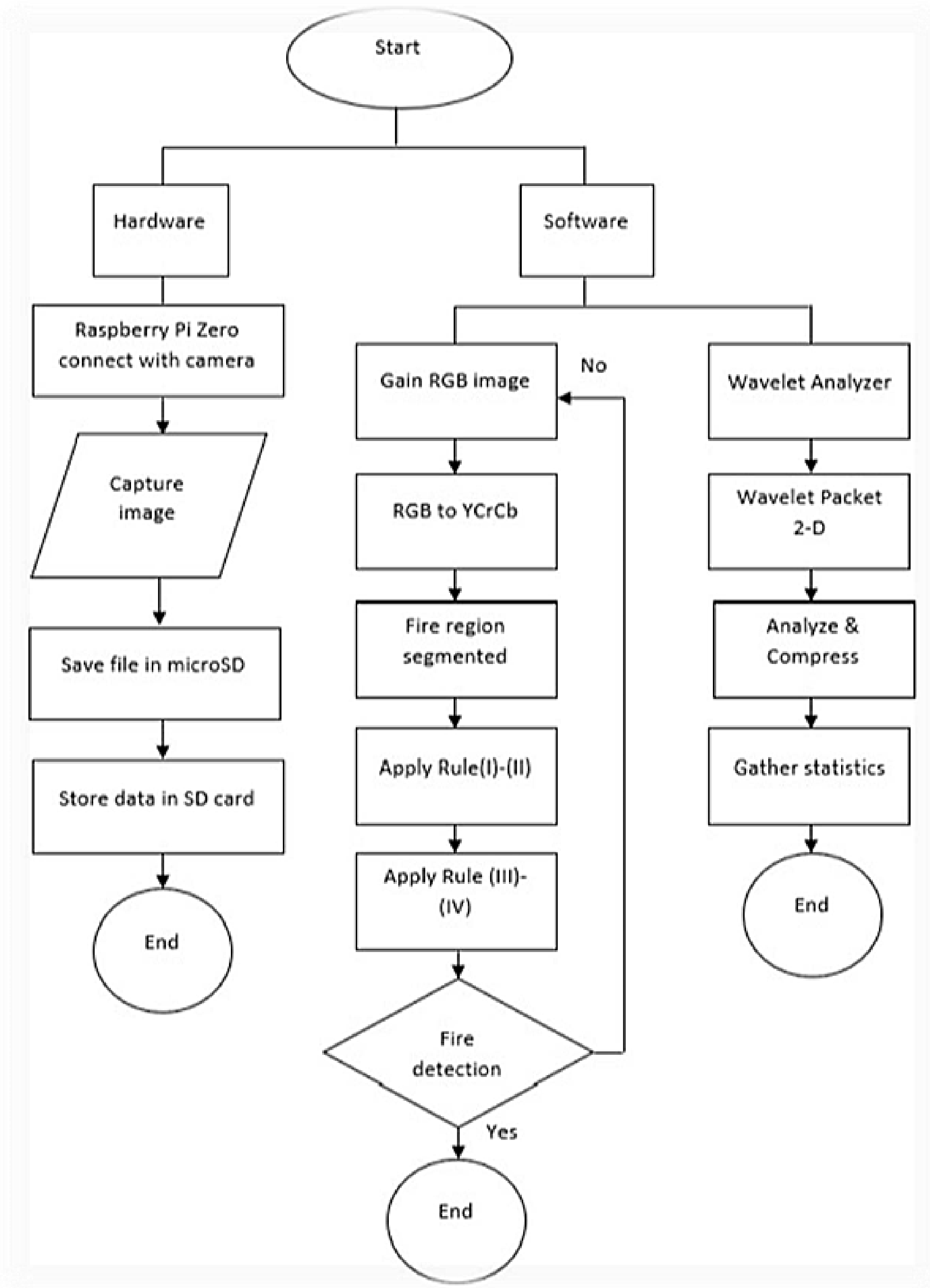
For years, American and Canadian forest fire research personnel have implemented information sharing and academic exchange, and promoted twoway forest fire research development. At the same time, the United States and other countries such as Spain, Portugal, and Australia have ance were the highest in the

engaged in long-term cooperation. This has facilitated an understanding of fire behavior, fire effects, vegetation dynamics, fire management strategy, the impact of socioeconomic factors on fire applications and fire fighting, and interactions between fires and global climate change. Possible future international cooperative studies include air quality management and understanding the regional and global impact of combustion products, assessing the influence of forest fire management strategy on the environment and benefits, large-scale monitoring and simulation of the influence of flammable vegetation cover management measures, flammable item mapping and monitoring methods and models for flammable item development and succession, and determining the mutual interaction between fires and other confounding factors.

Aerial Forest Preservation:

At the same time as forest fire prevention plans are implemented, improving firefighting ability has become a crucial topic for forest fire prevention organizations in various countries. The 1940s were the first stage of aerial forest preservation; firefighting in the 1940s primarily involved using airplanes to patrol, observe, and report fires. After the 1950s, countries with large forest areas generally developed aerial forest preservation, and began using airplanes to directly extinguish fires. The Taiwanese government first used the air fire brigade reserve from the National Fire Agency to directly fight fires in the 2002 Lishan forest fire. On March 10, 2004, the National Airborne Service Corps reserve of the Ministry of the Interior (hereafter referred to as the airborne corps) was formed, which integrated the Aerial Police Brigade of the National Police Agency, the air fire brigade from the National Fire Agency, the General
Aviation Squadron of the Civil Aeronautical Administration (Ministry of Transportation and Communications), and the official aerial fleet of the Coast Guard Administration's aerial reconnaissance corps. The airborne corps is responsible for coordinating service scheduling and providing support during land and sea disasters, rescue, medical aid, observation and patrol, and transportation tasks. The airborne corps cooperates closely with forestry units and fire fighting units in implementing various kinds of disaster relief training. They have managed multiple forest fires in recent years, and have used helicopters to directly suppress forest fires with satisfactory results (Chen, 2009). Current aerial forest preservation research primarily involves satellite forest fire monitoring by using plane-mounted infrared detection of ignition sources. Plane-mounted infrared can be used for conducting planned continuous tracking and monitoring of forest fire extensions. This enables various types of real-time dynamic information in major forest fire sites to be accurately grasped.

CHAPTER 5
FLOWCHART



CHAPTER 6
RESULT

FINAL RESULT OF PROJECT:

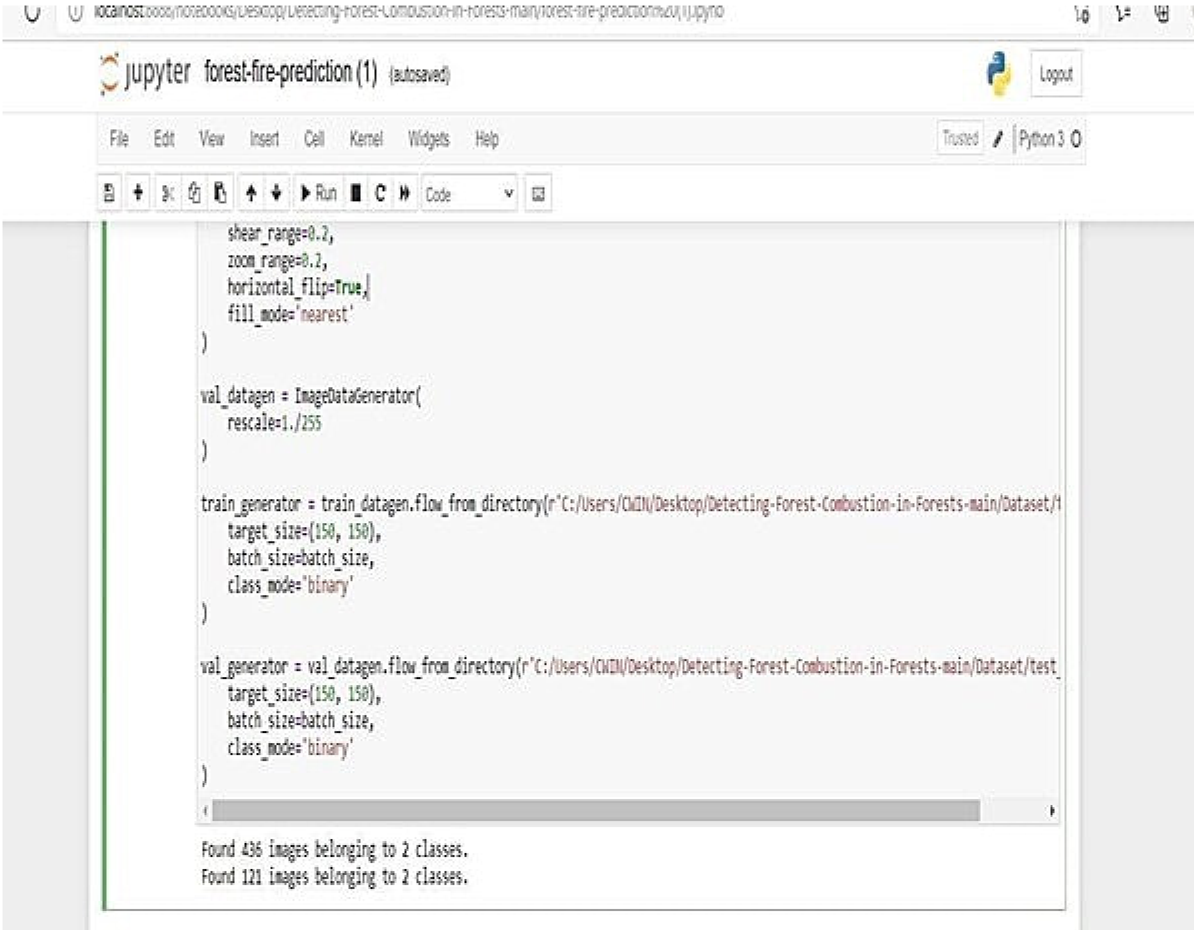


Fig: Data Generator Output

jupyter forest-fire-prediction (1) (unsaved changes)

File Edit View Insert Cell Kernel Widgets Help

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 148, 148, 32)      896
_________________________________________________________________
activation (Activation)      (None, 148, 148, 32)      0
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 74, 74, 32)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 72, 72, 32)        9248
_________________________________________________________________
activation_1 (Activation)    (None, 72, 72, 32)        0
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 36, 36, 32)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 34, 34, 64)        18496
_________________________________________________________________
activation_2 (Activation)    (None, 34, 34, 64)        0
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 17, 17, 64)        0
_________________________________________________________________
flatten (Flatten)            (None, 18496)             0
_________________________________________________________________
dense (Dense)                (None, 64)                1183808
_________________________________________________________________
activation_3 (Activation)    (None, 64)                0
_________________________________________________________________
dropout (Dropout)            (None, 64)                0
_________________________________________________________________
dense_1 (Dense)              (None, 1)                 65
_________________________________________________________________
activation_4 (Activation)    (None, 1)                 0
=================================================================
Total params: 1,212,513
Trainable params: 1,212,513
Non-trainable params: 0
```

jupyter forest-fire-prediction (1) (autosaved)

Logout

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Trusted | Python 3

Run Code

```
Trainable params: 1,212,513
Non-trainable params: 0
_________________________________________________________________
```

Train

In [3]:
```
model.fit(
    train_generator,
    epochs=10,
    validation_data=val_generator
)
```

```
Epoch 1/10
28/28 [==============================] - 22s 754ms/step - loss: 0.7136 - acc: 0.7018 - val_loss: 0.2517 - val_acc: 0.8595
Epoch 2/10
28/28 [==============================] - 21s 778ms/step - loss: 0.4565 - acc: 0.8440 - val_loss: 0.1586 - val_acc: 0.9587
Epoch 3/10
28/28 [==============================] - 21s 744ms/step - loss: 0.2864 - acc: 0.8830 - val_loss: 0.1199 - val_acc: 0.9587
Epoch 4/10
28/28 [==============================] - 22s 767ms/step - loss: 0.3006 - acc: 0.8716 - val_loss: 0.1322 - val_acc: 0.9504
Epoch 5/10
28/28 [==============================] - 21s 757ms/step - loss: 0.3728 - acc: 0.8899 - val_loss: 0.0691 - val_acc: 1.0000
Epoch 6/10
28/28 [==============================] - 22s 815ms/step - loss: 0.2525 - acc: 0.9060 - val_loss: 0.0962 - val_acc: 0.9669
Epoch 7/10
28/28 [==============================] - 22s 772ms/step - loss: 0.3209 - acc: 0.9151 - val_loss: 0.1381 - val_acc: 0.9256
Epoch 8/10
28/28 [==============================] - 20s 733ms/step - loss: 0.2545 - acc: 0.9037 - val_loss: 0.0492 - val_acc: 1.0000
Epoch 9/10
28/28 [==============================] - 19s 704ms/step - loss: 0.2310 - acc: 0.9060 - val_loss: 0.0578 - val_acc: 1.0000
Epoch 10/10
28/28 [==============================] - 20s 711ms/step - loss: 0.2171 - acc: 0.9289 - val_loss: 0.0417 - val_acc: 1.0000
```

Out[3]: `<keras.callbacks.History at 0x26d234c68b0>`

In [4]:
```
import matplotlib.pyplot as plt
```

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jupyter forest-fire-prediction (1) Last Checkpoint: 4 minutes ago (unsaved changes)

Logout

File Edit View Insert Cell Kernel Widgets Help

Trusted | Python 3

Run Code

In [4]:

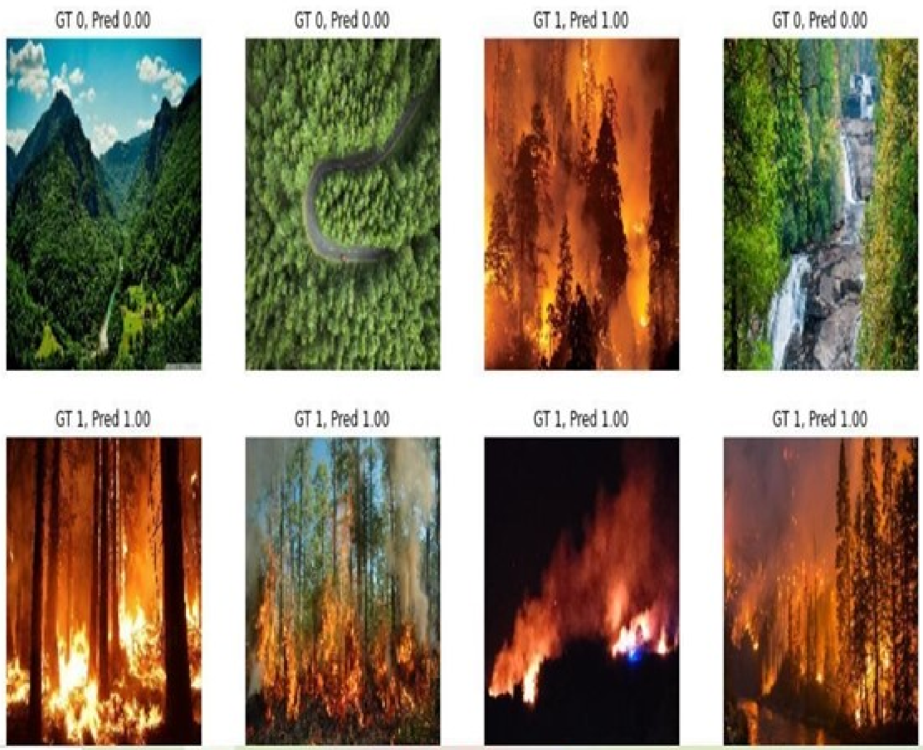
```
import matplotlib.pyplot as plt

val_imgs, val_labels = val_generator.__getitem__(0)

preds = model.predict(val_imgs)

fig, axes = plt.subplots(4, 4, figsize=(16, 16))

for img, label, pred, ax in zip(val_imgs, val_labels, preds, axes.flatten()):
    ax.imshow(img)
    ax.set_title('GT %d, Pred %.2f' % (label, pred))
    ax.set_axis_off()
```



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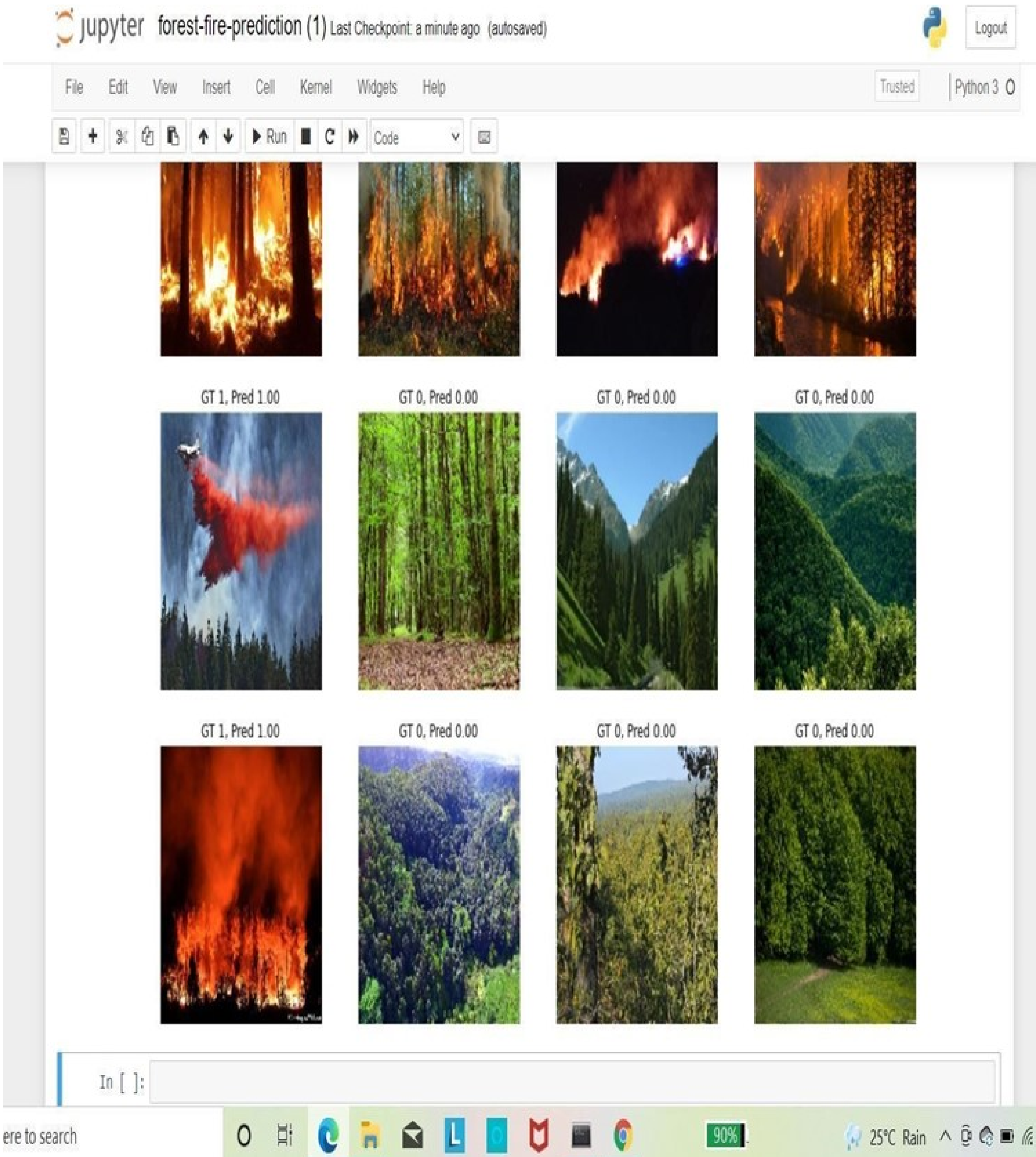
25°C Rain



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Run
Code
GT 1, Pred 1.00
GT 0, Pred 0.00
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GT 1, Pred 1.00
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GT 0, Pred 0.00
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90%
25°C Rain

Video streaming output

CHAPTER 7

ADVANTAGES AND DISADVANTAGES ADVANTAGES:

1. More dynamic and wider detection as compared to fixed sensors.
2. Reduction in cost.
3. Unreachable areas can now be controlled by MBSs.
4. To detect poaching, and monitor comprehensive animal deaths.
5. Proposed methods are very convenient and can easily detect.

DISADVANTAGES:

6. Possibility of lack of appropriate animals for special forests.
7. Determining climate conditions, daily temp differences, seasonal normal temp values, etc. are problematic.
8. Use of batteries create environmental pollution, introducing extra radiation and cadmium to the forest and animals.
9. Moreover, each battery needs to be changed periodically, but capturing the MBS to do this is not easy.

CHAPTER 8
APPLICATIONS

A. Property and life loss every year due to forest fire.
B. Need to detect fires before they spread.
C. Drop thousand of sensor nodes over fire-prone forest.
D. If a node detect fire it sends an alarm message (along with is location) to ranger station.
E. Nodes use multi-hop communication to cover large forest.
F. Military applications
G. Health applications
H. Commercial applications
I. Environmental applications
    1.Habitat monitoring
    2. Forest fire detection

CHAPTER 9

CONCLUSION

1. New wireless technologies and new satellite tracking systems can be adapted to increase the efficiency of the system.

2. New sensors can be produced or existing sensors can be improved to increase robustness of the proposed system.

3. A number of investigations can be made regarding animal behavior in case of fire to improve system reliadility.

CHAPTER 10 FUTURE SCOPE

FUTURE SCOPE OF FOREST FIRE DETECTION SYSTEM:

This project is easy to use. In this project, we designed an IoT based LoRa module used for forest fire detection system to detect fire as soon as possible, before the fire spread over the large area. FOREST FIRE DETECTION SYSTEM (FFDS) It is well known, there will be large variations/increase in temperature from the normal temperature whenever forest fire occurs. Thus, the enhancement of forest fire detection system by CO 2 (carbon dioxide) monitoring can be evaluated. 10, which contains three stages: color identification, movement recognition, and fire characterization. Design, installation and maintenance of the system. With the rapid development of digital camera technology and image processing technology, the flame detection method based on computer vision system has gradually replaced the traditional method and has become an important trend. traditional techniques of forest fires detection, wireless sensor networks (WSNs) technology is a very promising green technology for the future in detecting efficiently the forest fires. They have used Temperature and smoke sensor to detect the ignition alarming temperature and the level of carbon dioxide gas (CO_2). Forest fire detection. Continuous power … Mission Remote monitoring system Lesohranitel is intended for detection of forest fires at early stages. For the purpose of this study, Grand View Research has segmented the global fire protection systems market report on the basis of product, service, application, and region: Product Outlook (Revenue, USD Million, 2016 - 2027) Fire Detection. The forest has a network of nodes placed at suitable distances from each other, the nodes have a capability to communicate through devices (RF module in our case) and by using Arduino.

This can be detected/ monitored continuously by using temperature sensors and in accordance with the … A.A. Ahmad Alkhatib, A review on forest fire detection techniques, Int. The scope of application of Satellite Detection Systems is also restricted by a number of factors, reduces its effectiveness in Forest Fire Detection. Due to the demerits in Satellite-based Detection Systems, Wireless Sensor Network Technologywas used to detect Forest Fires and send the information to the computers in the Monitoring Centers. The process of detection of forest fire initiates at any of the nodes planted on atree inside the forest. 1) Why are fire detection & alarm systems installed? Fire detection in forest could also be possible if we used temperature sensors and humidity sensors along with the device which can also avoid wastage of Fire Analysis. In this paper, we discuss the design and implementation of a smart fire detection system using a Wireless Sensor Network (WSN) and Global System for Mobile (GSM) communication to detect fires effectively and reduce false positives. A fire detection system will help to improve early detection and prompt a rapid response.

FUTURE DEVELOPMENT:

1.Current smoke sensors inherently suffer from the transport delay of the smoke from the fire to the sensor. An automatic fire detection system relying on multi- Readmore. Here, temperature sensor collected data were sent to base station by both primary and main antennas (Alahi et al., 2017). Google Scholar When a fire burst, early detection is crucial to minimizing damage and saving lives. The Proposed System overcomes all the drawbacks of Currently, Forest Fire prevention methods largely consist of Patrolling, Observation from watch towers, Satellite Monitoring and Wireless Sensor Networks.

2.Types of alarm systems

2.1) Automatic alarm initiating devices

2.2) Heat detectors

2.3) Smoke detectors

2.4) Flame detectors

2.5) Fire – gas detectors

ANALYTICAL PROCEDURE: --

Most of the times, when someone notices about the fire, it is too late because the fire has spread already. Users are encouraged to use the FAST3.0 data in conjunction with other sources of forest fire detection and not solely rely on satellite based fire alerts for tactical firefighting. The objectives of this fire detector using arduino is to sense the surroundings for occurrence of fire with help of LM35 temperature sensor, and send 3 SMS alerts to two mobile numbers stored inside the arduino program if fire is detected (using GSM Module). 2014 (2014) 12. II. The recent advances in embedded processing have enabled the vision based systems to detect fire during surveillance using convolutional neural networks (CNNs). Fire Detection S ystem Using Image Processing Anjuman -I-Islam Kalsekar Technical Campus -Dept. Current remote sensor technologies are becoming more common, but … Conventional fire detection systems have a tendency of being triggered by false positives. We can replace the microcontroller by the Arduino board. The main need for choosing this particular application for the detection of forest fires is to overcome the demerits present in the existing technologies of MODIS and Basic Wireless Sensor Network-based Forest Fire Detection Systems and an advanced system is developed for the detection of forest fires. INTRODUCTION Abstract-In this paper, we present a wireless sensor network for detection of forest fires. They relied on the clustering algorithm as routing techniques to collect the measurement from the scattered sensors such as humidity, temperature, smoke, and wind speed where this data was used as input for The United States

National Fire Danger Rating System. The system will be integrated with several sensors to

detect fire and motion. The use of MATLAB instead of the conventional Arduino software made the process less cumbersome and left scope for future improvements.

PROCEDURE IN DETERMINATION OF PH IN TREE AND SOIL:

Traditional forest fire monitoring system, the program is good at flexible structure, low onetime cost, easy operation, wide expansion and better promotional value. Future scope of our method is as follows: The system can be made weatherproof. The IFFED system is an integrated forest fire detec-tion and management system based on the use of obser-vation points essentially consisting of towers supporting Period biol, Vol 110, No 2, 2008. Based Forest Fire Detection system is the detection of a fire by the smoke plume (capture and detection of lesion) or by the change of temperature (using infrared cameras).

A Survey on WSN-based Forest Fire Detection Techniques Waqas Ali, Abdullah, Ishfaqurrashid Department of Computer Science, Abdul Wali Khan University Mardan, Pakistan ABSTRACT In this paper, we will present a survey on existing studies of forest fire detection system…

CHAPTER 11
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