

**DETECTING FIRE COMBUSTION IN FORESTS USING IBM
WATSON STUDIO**

A Project Report submitted to

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY,
HYDERABAD**

In partial fulfilment for the requirement for the award of the degree of

BACHELOR OF TECHNOLOGY

In

Computer Science and Engineering.

SUBMITTED BY

V.SANGEETHA

18UK1A05B9

KANCHA DHEERAJ

18UK1A0578

POLSANI RUCHITHANJALI

18UK1A0596

DEEKSHA KOMATI

18UK1A05D0

Under the esteemed guidance of

Ms. M. SWETHA

Assistant Professor CSE Department



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

VAAGDEVI ENGINEERING COLLEGE

Affiliated to JNTUH, Hyderabad

BOLLIKUNTA, WARANGAL (T.S)-506005

**DEPARTMENT OF COMPUTER SCIENCE AND
ENGINEERING**

VAAGDEVI ENGINEERING COLLEGE



CERTIFICATE

This is to certify that the Mini Project Report entitled **“DETECTING FIRE COMBUSTION IN FORESTS USING IBM WATSON STUDIO”** is submitted by **V. SANGEETHA (18UK1A05B9), K. DHEERAJ (18UK1A0578),**

P. RUCHITHANJALI (18UK1A0596), K. DEEKSHA (18UK1A05D0) in partial fulfilment of the requirements for the award of the Degree in Bachelor of Technology in computer science and engineering during the academic year 2018-2022.

EXTERNAL

ACKNOWLEDGEMENT

We wish to take this opportunity to express our sincere gratitude and deep sense of respect to our beloved **Dr. P. PRASAD RAO**, Principal, Vaagdevi Engineering College for making us available all the required assistance and for his support and inspiration to carry out this mini project in the institute.

We extend our heartfelt thanks to **Dr. R. NAVEEN KUMAR**, Head of the Department of CSE, Vaagdevi Engineering College for providing us necessary infrastructure and thereby giving us freedom to carry out the mini project.

We express heartfelt thanks to the Mini Project Coordinator, **Ms. ARUNA KRANTHI** assistant professor, Department of Computer Science and Engineering, Vaagdevi Engineering college, for their constant supervision as well as for providing necessary information regarding the major project and for their support in completing the major project.

We express heartfelt thanks to the guide, **Ms. M. SWETHA** Assistant professor, Department of CSE for his constant support and giving necessary guidance for completion of this major project.

Finally, we express our sincere thanks and gratitude to my family members, friends for their encouragement and outpouring their knowledge and experiencing throughout thesis.

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.

INDEX

TITLE	PAGE NO
1.CHAPTER: INTRODUCTION	1
1.1 OVERVIEW	
1.2 PURPOSE	
2.CHAPTER: LITERATURE SURVEY	2
2.1 EXISTING PROBLEM	
2.2 PROPOSED SOLUTION	
3.CHAPTER: THEORITICAL ANALYSIS	3-4
3.1 BLOCK DIAGRAM	
3.2 HARDWARE/SOFTWARE DESIGNING	
4.CHAPTER: EXPERIMENTAL INVESTIGATIONS	5-7
5.CHAPTER: FLOWCHARD	8
6.CHAPTER: RESULT	9-14
7.CHAPTER: ADVANTAGES & DISADVANTAGES	15
8.CHAPTER: APPLICATIONS	16
9.CHAPTER: CONCLUSION	17
10.CHAPTER: FUTURE SCOPE	18-20
11.CHAPTER: BIBILOGRAPHY	21-27

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;

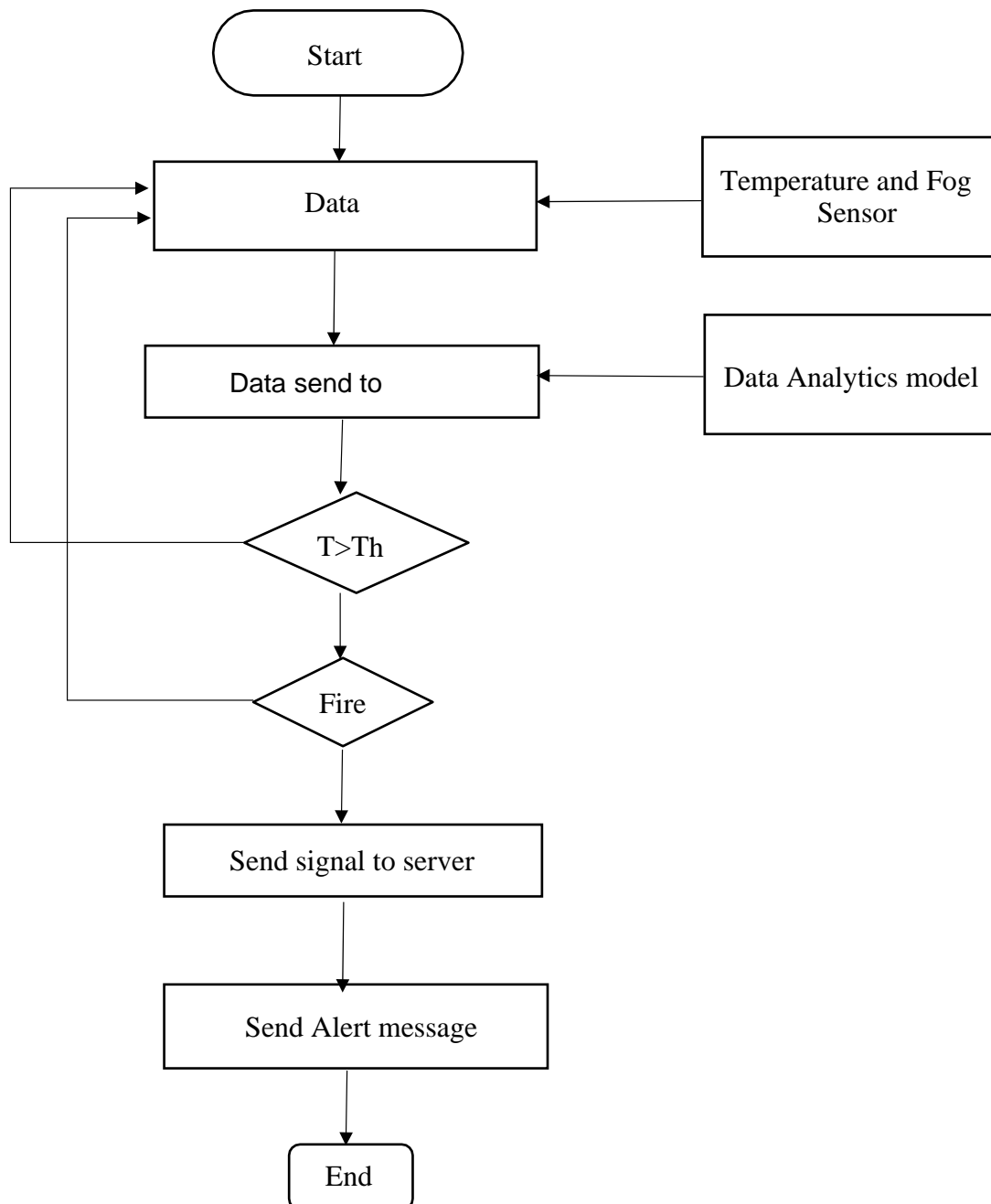
Carefully extinguish smoking mat

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 Jupyter 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 ML-powered applications.

Keras:

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

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

open cv:

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

- Type “pip install numpy” and click enter.
- Type “pip install pandas” and click enter.
- Type “pip install matplotlib” and click enter.
- Type “pip install scikit-learn” and click enter.
- Type "pip install tensorflow==1.14.0" and click enter.
- Type "pip install keras=2.2.4" and click enter.
- Type "pip install opencv-python" and click enter.
- Type “pip install Flask” and click enter.

CHAPTER 4

EXPERIMENTAL INVESTIGATIONS

Jan-Chang Chen, Chaur-Tzuhn Chen, in [Wildfire Hazards, Risks and Disasters](#), 2015 Forest Fire Research Prospects

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. Taiwan's forestry department currently uses the study results of Hsiao (2003). Hsiao's study used a given day's highest temperature, temperature variation, accumulated period without rainfall, and drought index as weather factors to derive forest fire incident in a logistical regression model, and built a forest fire ignition probability model. 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 importance were the highest in the

arson 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. Assessments can also significantly contribute toward international cooperation and implementing new coordinated policies.

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. Forest fires in Taiwan included 406 fire alarms, 243 fires, 5,165 ha destroyed, costing an estimated NT\$ 825,045,000.

Because forest management requires long periods of time, the restoration of forests requires large capital and labor investments, as well as long waiting periods. Hsieh et al. (2003) used satellite images to assess forest fire losses. 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 engaged in long-term cooperation. This has facilitated an understanding of fire behavior, fire

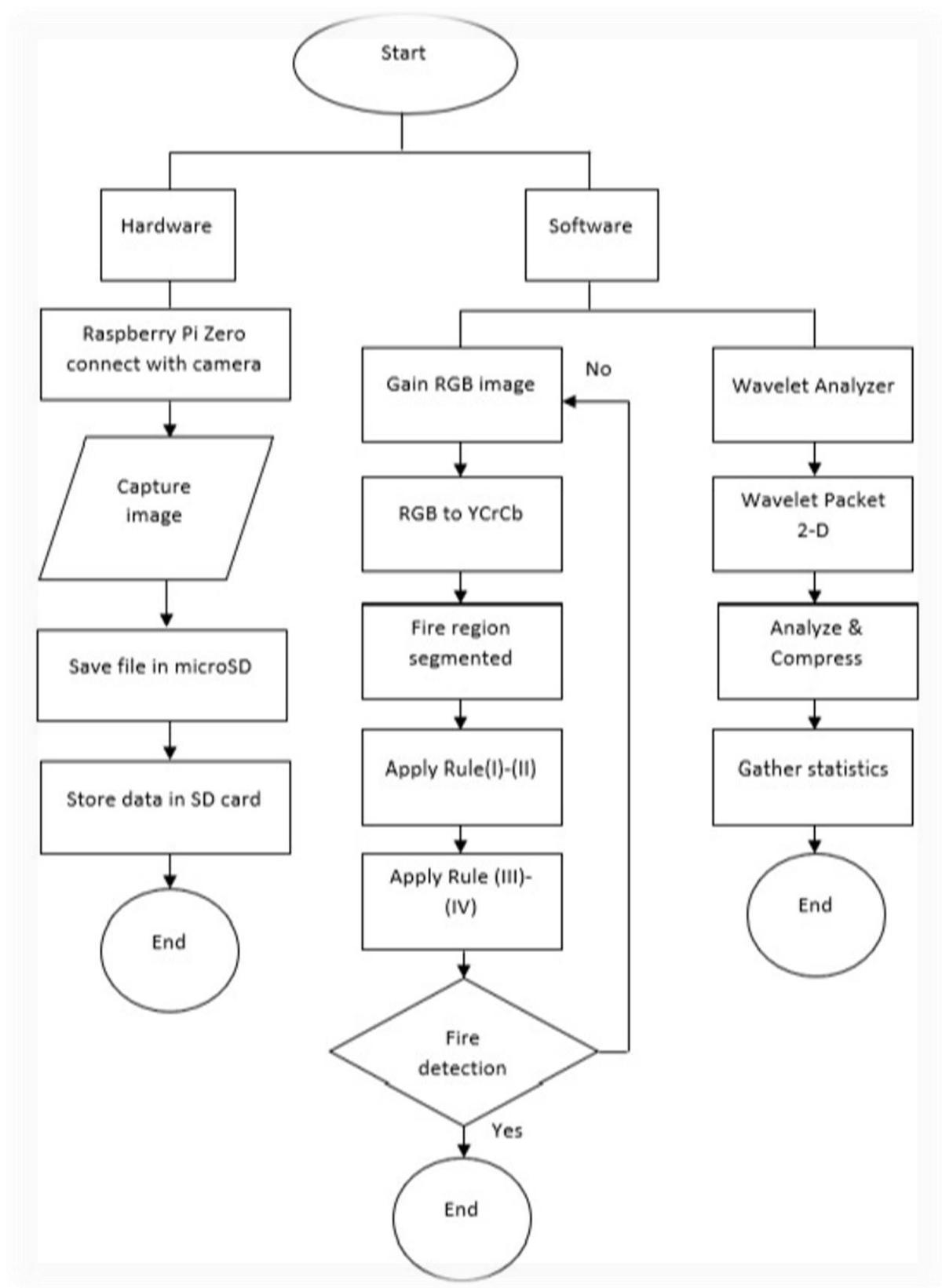
effects, vegetation dynamics, fire management strategy, the impact of socioeconomic factors on fire applications and fire fighting, and interactions between fires and global climate change. Possible future international cooperative studies include air quality management and understanding the regional 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

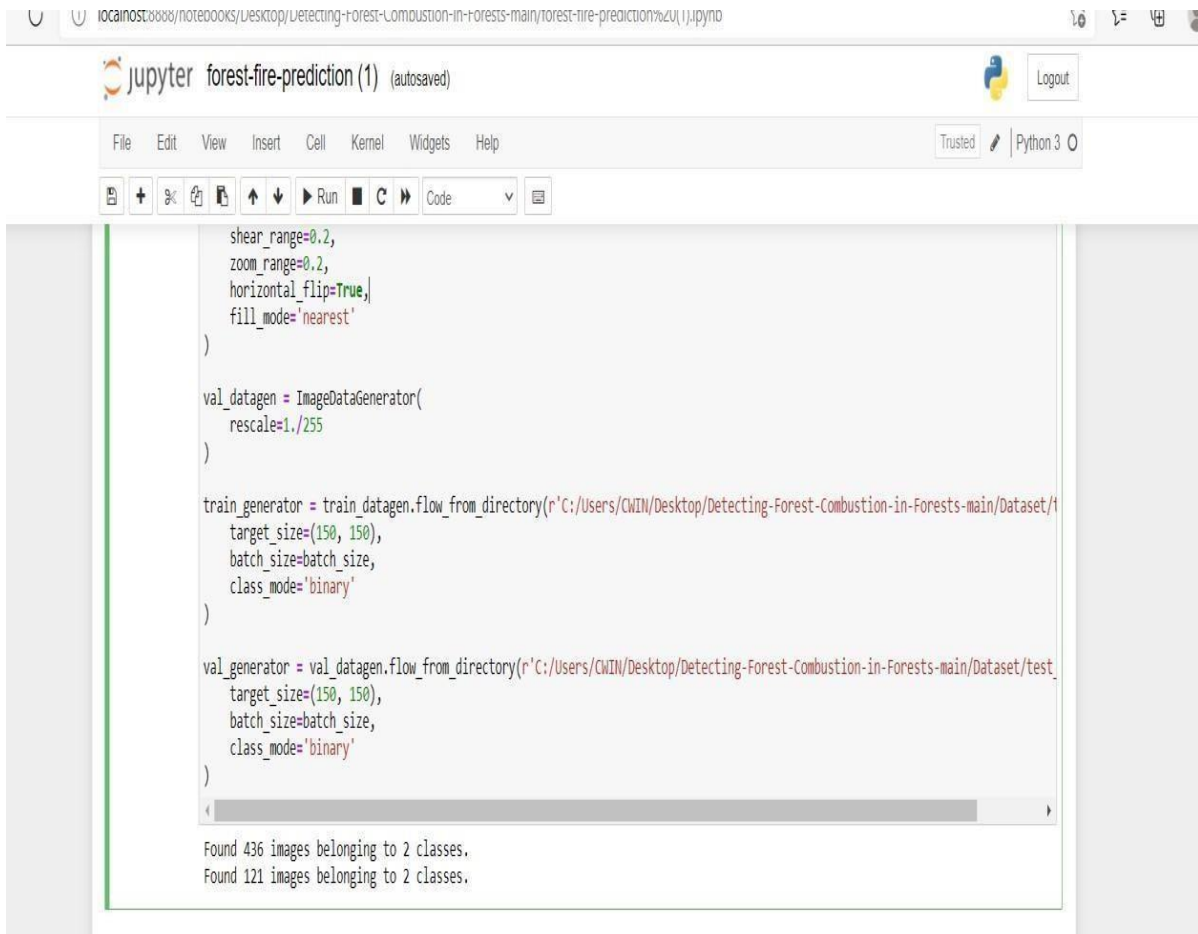
FLOWCHART



CHAPTER 6

RESULT

FINAL RESULT OF PROJECT:



```
shear_range=0.2,
zoom_range=0.2,
horizontal flip=True,
fill_mode='nearest'
)

val_datagen = ImageDataGenerator(
    rescale=1./255
)

train_generator = train_datagen.flow_from_directory(r'C:/Users/CWIN/Desktop/Detecting-Forest-Combustion-in-Forests-main/Dataset/train',
    target_size=(150, 150),
    batch_size=batch_size,
    class_mode='binary'
)

val_generator = val_datagen.flow_from_directory(r'C:/Users/CWIN/Desktop/Detecting-Forest-Combustion-in-Forests-main/Dataset/test',
    target_size=(150, 150),
    batch_size=batch_size,
    class_mode='binary'
)

Found 436 images belonging to 2 classes.
Found 121 images belonging to 2 classes.
```

Fig: Data Generator Output

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

File Edit View Insert Cell Kernel Widgets Help

Run

```
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 (MaxPooling2D)	(None, 36, 36, 32)	0
conv2d_2 (Conv2D)	(None, 34, 34, 64)	18496
activation_2 (Activation)	(None, 34, 34, 64)	0
max_pooling2d_2 (MaxPooling2D)	(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
```

Search here to search

100%

Fig: Build Model Output

jupyter forest-fire-prediction (1) (autosaved) Python 3 Logout

File Edit View Insert Cell Kernel Widgets Help

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
```

Search here to search

93% 25°C Rain

Fig: Train output 1

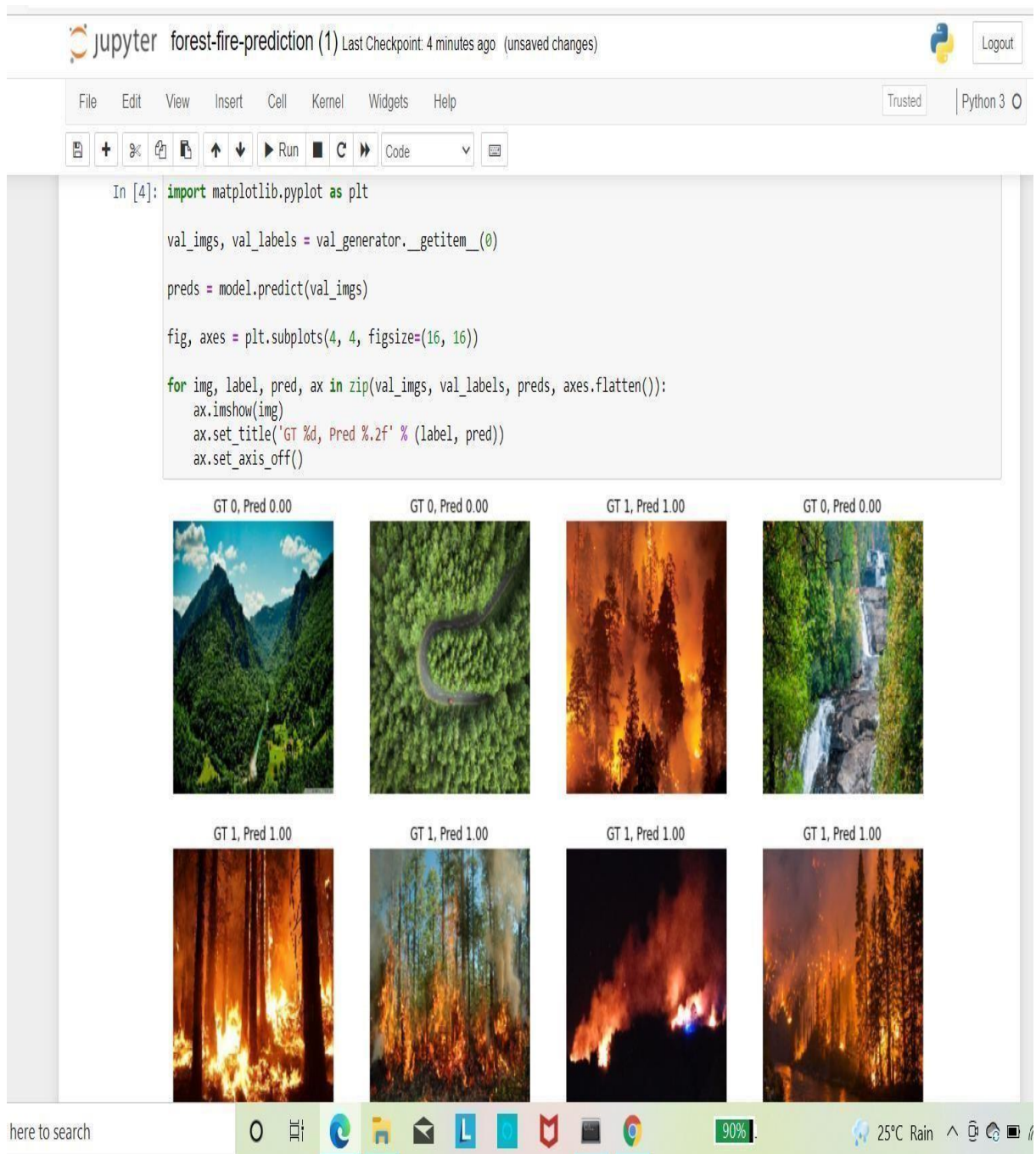


Fig: Train Output 2.1

Jupyter forest-fire-prediction (1) Last Checkpoint: a minute ago (autosaved) Logout

File Edit View Insert Cell Kernel Widgets Help Trusted Python 3

Run Code

Image	GT	Pred
	1	1.00
	0	0.00
	0	0.00
	0	0.00
	1	1.00
	0	0.00
	0	0.00
	0	0.00
	0	0.00
	0	0.00
	0	0.00
	0	0.00

In []:

ere to search

90%

25°C Rain

Fig: Train Output 2.1



Video streaming output

CHAPTER 7

ADVANTAGES AND DISADVANTAGES

ADVANTAGES:

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

DISADVANTAGES:

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

CHAPTER 8

APPLICATIONS

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

CHAPTER 9

CONCLUSION

- New wireless technologies and new satellite tracking systems can be adapted to increase the efficiency of the system.
- New sensors can be produced or existing sensors can be improved to increase robustness of the proposed system.
- A number of investigations can be made regarding animal behavior in case of fire to improve system reliability.

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 CO₂ (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 (CO₂). 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. Traditional forest fire detection methods include satellite monitoring, ground patrols, watch towers, among others, which have high labor and financial costs in return for low efficiency. It concentrates in particular on systems that use image and video processing for converting visual data into a form that can be understood by the computer program. System Optimization and Delay Reduction i.e. Forest Fire Detection System Project Description: Forest Fire Detection System- This project is based on image processing based forest fire detection along with an email notification. 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, which reduces its effectiveness in Forest Fire Detection. Due to the demerits in Satellite-based Detection Systems, Wireless Sensor Network Technology was 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 a tree 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 valuable 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. In this paper a forest fire detection algorithm is proposed, and it consists MATLAB helps in designing the system in a simple and lucid

manner. This work describes a forest fire controller based on fuzzy logic and decision-making methods aiming at enhancing forest fire prevention, detection, and fighting systems. J. present a real-time forest fire detection system by using neural wireless sensor networks.

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 detection and management system based on the use of observation 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, Ishfaq-urrashid 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...

Jennings Mill Subdivision Athens, Ga, Does Mexico Have A Dominant Party System, Black Specks In Urine Mayo Clinic, Fort Joy Two-handed Weapons, Mgccc Financial Aid Office Phone Number, Tavernkeep Terraria Died.

CHAPTER 11

BIBLIOGRAPHY

- Andreae, M.O.** 2004. Assessment of global emissions from vegetation fires. *International Forest Fire News*, 31: 112–121.
- Bahuguna, V.K. & Singh, S.** 2002. Fire situation in India. *International Forest Fire News*, 26: 23–27.
- Barbosa, R. & Fearnside, P.** 1999. Incêndios na Amazônia brasileira: estimativa da emissão de gases do efeito estufa pela queima de diferentes ecossistemas de Roraima na passagem do Evento “El Niño” (1997/98). *Acta Amazonica*, 29: 513–534.
- Bolivia, Gobierno de.** 2004. Bolivia declara emergencia por incendios forestales. La Paz, Bolivia (puede consultarse en <http://www.desastres.org/noticias.asp?id=17092004-1> [consulta 28 enero de 2005]).
- Carroll, R.** 2005. Africa’s first regionwide conservation treaty signed at historic Congo Basin forest summit. WWF Press Release 2/5/2005 (available at www.worldwildlife.org/news/displayPR.cfm?prID=179).
- Casaza, J.** 2005a. Informe del Taller Técnico Subregional de Mesoamérica, Ciudad de Panamá, Panamá, 24–26 de mayo de 2005. Proyecto TCP/RLA/3010 (C) – Desarrollo de una Estrategia Regional de Cooperación para la Prevención, Control y Combate de Incendios Forestales. Santiago, Chile, Oficina Regional de la FAO para América Latina y el Caribe.
- Casaza, J.** 2005b. Informe de la Reunión Regional de América Latina y el Caribe, Santiago, Chile, 3–4 de noviembre de 2005. Proyecto TCP/RLA/3010 (C) – Desarrollo de una Estrategia Regional de Cooperación para la Prevención, Control y Combate de Incendios Forestales. Santiago, Chile, Oficina Regional de la FAO para América Latina y el Caribe.
- Chhetri, D.B.** 1994. Seasonality of forest fires in Bhutan. *International Forest Fire News*, 10: 5–9.
- Darlong, V.T.** 2002. Traditional community-based fire management among the Mizo shifting cultivators of Mizoram in northeast India. In *Communities in flames: Proceedings of an International Conference on Community Involvement in Fire Management*. RAP Publications 2002/25. Bangkok, Thailand, FAO Regional Office for Asia and the Pacific.
- Eckelmann, C.M.** 2004. Summary of working group presentations to identify the underlying causes of wildfires and recommendations for national forest fire management programmes. 12th Caribbean Foresters Meeting, held at the International Institute of Tropical Forestry, Rio Piedras, Puerto Rico, 8– 11 June 2004.
- Ellis, S., Kanowski, P. & Whelan, R.** 2004. National inquiry on bushfire mitigation and management, Canberra, Commonwealth of Australia.
- FAO.** 2001a. Global forest fire assessment 1990–2000. FRA Working Paper 55. Rome.

- FAO.** 2001b. Global Forest Resources Assessment 2000 – main report. FAO Forestry Paper No. 140. Rome.
- FAO.** 2002a. Guidelines on fire management in temperate and boreal forests. Forest Protection Working Papers, Working Paper FP/1/E. Rome.
- FAO.** 2003. State of the World's Forests 2003. Rome.
- FAO.** 2005a. State of the World's Forests 2005. Rome.
- FAO.** 2005b. Statement of the Ministerial Meeting on Forests, 14 March 2005 (available at www.fao.org/forestry/site/26480/en). In Proceedings of the 128th session of the FAO Council, Rome, 20–25 June 2005 (also available at (www.fao.org/docrep/meeting/009/j5108e.htm)).
- FAO.** 2005c. Report of the Seventeenth Session of the Committee on Forestry, Rome, 15–19 March 2005, (also available at www.fao.org/docrep/meeting/009/j5015e.htm).
- FAO.** 2005d. Global Forest Resources Assessment 2005. Country Profiles. Rome.
- FAO.** 2006a. Global Forest Resources Assessment 2005 – progress towards sustainable forest management. FAO Forestry Paper No. 147. Rome.
- FAO.** 2006b. Fire in the agriculture-forestry interface. Report presented at the 24th FAO Regional Conference for Africa, Bamako, Mali, 30 January – 3 February 2006 (also available at [ftp://ftp.fao.org/unfao/bodies/arc/24arc/J6883E.pdf](http://ftp.fao.org/unfao/bodies/arc/24arc/J6883E.pdf)).
- FAO & GFMC.** 2003. FAO wildland fire management terminology, 1986, updated jointly with GFMC (available at www.fire.uni-freiburg.de/literature/glossary.htm).
- Galindo, G.** 2005. Los incendios forestales en Ecuador. Quito, Ecuador, Ministerio del Ambiente, Dirección nacional Forestal.
- Ganz, D.** 2003. Framing fires: a country-by-country analysis of forest and land fires in the ASEAN nations. Bogor Barat, Indonesia, Project FireFight South East Asia.
- GFMC.** 2003. Web page on current and archived significant global fire events and fire season summaries. Freiburg, Germany, Global Fire Monitoring Center (available at <http://www.fire.unifreiburg.de/current/globalfire.htm>).
- GFMC.** 2004a. International Wildland Fire Summit. Freiburg, Germany (available at www.fire.unifreiburg.de/summit-2003/introduction.htm).
- GFMC.** 2004b. Global wildland fire assessment. Freiburg, Germany (available at <http://www.fire.unifreiburg.de/inventory/assessment.htm>).
- GFMC.** 2005a. Framework for the development of the International Wildland Fire Accord. Freiburg, Germany (available at <http://www.fire.uni-freiburg.de/GlobalNetworks/GlobalWildland-FireFramework-12-April-2005.pdf>).
- GFMC.** 2005b. Conclusions, Regional Balkan Wildland Fire Network/Global Wildland Fire Network International Technical and Scientific Consultation “Forest Fire Management in the Balkan Region”

Ohrid, Macedonia, 4–5 April 2005 (available at www.fire.unifreiburg.de/GlobalNetworks/SEEurope/Ohrid-Conclusions-5-April2005final.pdf).

GFMC. 2006a. Emergency assistance through the United Nations and the GFMC. Freiburg, Germany (available at www.fire.uni-freiburg.de/emergency/un_gfmc.htm).

GFMC. 2006b. Towards the development of a global early warning system for wildland fire. Freiburg, Germany (available at <http://www.fire.uni-freiburg.de/fwf/EWS.htm>).

Goldammer, J.G. 2000. The Ethiopia fire emergency between February and April 2000. *International Forest Fire News*, 22: 2–8 (also available at www.fire.uni-freiburg.de/iffn/country/et/et_1.htm).

Goldammer, J.G. 2003a. The wildland fire season 2002 in the Russian Federation. An assessment by the Global Fire Monitoring Center (GFMC). *International Forest Fire News*, 28: 2–14.

Goldammer, J.G. & de Ronde, C., eds. 2004. *Wildland fire management handbook for subSahara Africa*. Freiburg, Germany, Global Fire Monitoring Center; and Cape Town, South Africa, Oneworldbooks.

Goldammer, J.G., Frost, P.G.H., Jurvélius, M., Kamminga, E.M., Kruger, T., Ing Moody, S. & Pogeyed, M. 2002. Community participation in integrated forest fire management: experiences from Africa, Asia and Europe, pp. 33–52. In P. Moore, D. Ganz, L. Cheng Tan, T. Enters & P.B. Durst, eds. *Communities in flames. Proceedings of an International Conference on Community Involvement in Fire Management*, 25–28 July 2001, Balikpapan, Indonesia. RAP Publication 2002/25. Bangkok, Thailand, FAO Regional Office for Asia and the Pacific (RAP).

Goldammer, J.G., Sukhinin, A. & Csiszar, I. 2004. The current fire situation in the Russian Federation: implications for enhancing international and regional cooperation in the UN framework and the global programs on fire monitoring and assessment, pp. 26–65. In *Fire management at an ecoregional level. International experience and new approaches in forest sector reforms*. World Bank and Program on Forests (PROFOR). Moscow, Alex Publishers (in Russian).

González, J.E. & Sierra, J. 2004. Forestry activities in the Dominican Republic: emphasizing forest fires. Paper presented at the 12th Caribbean Foresters Meeting, held at the International Institute of Tropical Forestry, Rio Piedras, Puerto Rico, 8–11 June 2004.

Handmer, J. 2003. Institutions, and bushfires: fragmentation, reliance and ambiguity, pp. 139–149. In G. Cary, D. Lindenmeyer & S. Dover, eds. *Australia burning; fire ecology, policy and management*. Collingwood, Victoria, Australia, CSIRO Publishing.

Isaac, C. 2004. Wildland fire management in Saint Lucia. Paper presented at the 12th Caribbean Foresters Meeting, held at the International Institute of Tropical Forestry, Rio Piedras, Puerto Rico, 8–11 June 2004.

James, A. & Dupuis, J. 2004. Impact of bush fires on the vegetation of Dominica. Paper presented at the 12th Caribbean Foresters Meeting, held at the International Institute of Tropical Forestry, Rio Piedras, Puerto Rico, 8–11 June 2004.

Jones, N. 2004. Wildland fires, management and restoration (in Barbados). Paper presented at the 12th Caribbean Foresters Meeting, held at the International Institute of Tropical Forestry, Rio Piedras, Puerto Rico, 8–11 June 2004.

JRC-EU. 2005. SAFARI 2000 global burned area map, 1-km, Southern Africa, 2000. Data set. Ispra, Varese, Italy, Joint Research Centre, European Commission (www.jrc.ec.europa.eu/). Available online from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee (http://daac.ornl.gov/S2K/guides/spot_veg_burned.html).

Kafle, S.K. & Sharma, S. 2005. Global wildland fire assessment 2004: Nepal. Report on file at GFMC. Freiburg, Germany, Global Fire Monitoring Center.

Kondrashov, L.G. 1999. Politika Rossii po snizheniu vybrosov ugleroda. Lesnoe khozyaistvo Dalnego Vostoka na rubezhe vekov (Russia's policy to decrease carbon emissions. Far East forestry on the edge of centuries). Khabarovsk.

Kunwar, M. & Khaling, S. 2005. Forest fire in Terai, Nepal. Causes and community management interventions. International Forest Fire News. (in press)

Kuzmichev, Y.P., Kolomytsev, V.M. & Chekurdaev, G.A. 2004. Opportunities and prospects of mobilizing the public opinion in the region for promotion of wildfire prevention activities, pp. 74–80. In Fire management at an ecoregional level. International experience and new approaches in forest sector reforms. World Bank and Program on Forests (PROFOR). Moscow, Alex Publishers (in Russian).

Lopes, A.; Sousa, A. & Viegas, D. 2002. Numerical simulation of turbulent flow in fire propagation in complex topography. In Short course on forest fire behaviour. Luso, Portugal, ADAI (Associação para o Desenvolvimento da Aerodinâmica Industrial).

López, M.A. 2004. Central America and Mexico regional brief on international cooperation in wildland fire management. Paper presented at the PanAmerican Wildland Fire Conference, San José, Costa Rica, 21–24 October 2004. Guatemala City, Guatemala, Instituto Nacional de Bosques.

Macedonia, Republic of. 2005. Technical report of the International Technical and Scientific Consultation, “Forest Fire Management in the Balkan Region”, Ohrid, Macedonia, 4–5 April 2005. University “Sts. Kiril and Metodij”, Faculty of Forestry, Skopje (available at www.fire.uni-freiburg.de/GlobalNetworks/SEEurope/REPORTOhrid-2005-final.pdf).

Manta, M. & León, H. 2004. Los incendios forestales del Perú: grave problema por resolver. Floresta (Brasil), 34(2): 179–189.

Martínez, I. & Cordero, W. 2003. Fire situation in Bolivia. International Forest Fire News, 28: 41–44.

Murdiyaso, D. & Lebel, L., eds. 2006. Forest and land fires in Southeast Asia: local and global perspectives. Journal for Mitigation and Adaptation Strategies for Global Change. (in preparation)

Mutch, R. 2003. Fire situation in Brazil. International Forest Fire News, 28: 45–50.

Nepstad, D., Moreira, A., Alencar, A. 1999. Flames in the rain forest: origins, impacts and alternatives to Amazonian fires. Brasilia, Brazil, Pilot Program to Preserve the Brazilian Rain Forest.

Nepstad, D., Carvalho, G.; Barros, A. & Alencar, A. 2001. Road paving, fire regime feedbacks and the future of Amazon forests. Forest Ecology and Mangement, 5524: 1–43.

Ostroschenko, V.V. 2000. Forest fires in Priokhotie, their impact on forest biogeocenoses. Khabarovsk.

Polanco, C. & Javier, F. 2002. Taller de capacitación del software Desinventar para incendios forestales, Corantioquia, del 15 al 16 de noviembre de 2002, Medellín, Colombia. Antioquia, Corantioquia, Departamento de Geología, Universidad EAFIT/ Corporación Autónoma Regional del Centro de Antioquia.

Pyne, S.J., Goldammer, J.G., de Ronde, C., Geldenhuys, C.J., Bond, W.J. & Trollope, W.S.W. 2004. Introduction, pp. 1–10. In J.G. Goldammer & C. de Ronde, eds. Wildland fire management handbook for sub-Saharan Africa. Freiburg, Germany, Global Fire Monitoring Center; and Cape Town, South Africa, Oneworldbooks.

Ramos Rodríguez, M.P. 2004. Caribbean regional brief on international cooperation in wildland fire management. Paper presented at the Pan-American Conference on Wildland Fire, San José, Costa Rica, 21–24 October 2004. International Forest Fire News, 31: 58–60.

Rodríguez, N. 2000. Wildfires in the Andean Patagonia region of Argentina. International Forest Fire News, 23: 54–57.

Sanhueza, P. 2003. Forest fire situation in Chile. International Forest Fire News, 28: 57–65.

Scholz, C. 2005. Documento base para elaborar la estrategia Mesoamericana de cooperación en el manejo del fuego (informe preliminar) (Background paper to elaborate the cooperative Mesoamerican strategy in fire management). Proyecto FAO TCP/RLA/3010(C): Desarrollo de una Estrategia Regional de Cooperación para la Prevención, Control y Combate de Incendios Forestales. (mimeo)

Sharma, S.S. 2005. Nepal: participatory forest fire management: an approach. International Forest Fire News. (in press)

- Shields, B.J.** 2004. A review of fire behaviour in tropical regions for the Gesellschaft für Technische Zusammenarbeit (GTZ) Integrated Forest Fire Management Project, East Kalimantan. Internal report. (unpublished)
- Shu Lifu.** 1998. The study and planning of firebreaks in China. *International Forest Fire News*, 19: 51.
- Shu Lifu, Wang Mingyu, Tian Xiaorui & Du Yongsheng.** 2004. Forest fires environment and occurrence in China, p. 44. In *Forest Fire Suppression Techniques Northeast Asia Region International Symposium*. Seoul, 2004.
- Silva, M.E.** 2003. Fire situation in Colombia. *International Forest Fire News*, 28: 66–72.
- Singh, K. & Adam, A.** 2004. Country report for Trinidad: wildland fire, management and restoration. Paper presented at the 12th Caribbean Foresters Meeting, held at the International Institute of Tropical Forestry, Rio Piedras, Puerto Rico, 8–11 June 2004.
- Srivastava, R.K.** 1999a. Controlling forest fire incidences by generating awareness. A case study from Nilgiri Biosphere Reserve, Coimbatore, India. *International Forest Fire News*, 20: 10–15.
- Srivastava, R.K. & Singh, D.** 2003. Forest fire, haze pollution and climate change. Special issue: Climate change and forestry – Part I. *Indian Forester*, 129: 725–734.
- Tamburi, P.** 2004. Incendios forestales en Uruguay. Sección Prevención de Incendios Forestales. Dirección General Forestal, Ministerio de Ganadería, Agricultura y Pesca. Montevideo, Uruguay. 5 p.
- Telitsyn, G.P.** 1988. Forest fires, their prevention and suppression in Khabarovsk Territory. Khabarovsk.
- Thomas, A.** 2004. Wildfire management and restoration in Grenada. Paper presented at the 12th Caribbean Foresters Meeting, held at the International Institute of Tropical Forestry, Rio Piedras, Puerto Rico, 8–11 June 2004.
- UNEP.** 2002. Spreading like wildfire: tropical forest fires in Latin America and the Caribbean. México, D.F., México. United Nations Environment Programme Regional Office for Latin America and the Caribbean.
- UN-ISDR.** 2006. Working group 4: wildland fire. Freiburg, Germany (available at www.unisdr.org/eng/task%20force/tf-working-groups4-eng.htm).
- Viegas, D.X.** 1997. Forest fire origin, behaviour and evolution, pp. 29–49. In P. Balabanis, G. Eftichidis and R. Fantechi, eds. *Forest fire risk and management*. Proceedings of the European

School of Climatology and Natural Hazards course. Porto Canas, Halkidiki, Greece, Office for Official Publications of the European Communities, European Commission.

WHO/UNEP/WMO. 1999a. Health guidelines for vegetation fire events. Guideline document. D.H. Schwela, J.G. Goldammer, L.H. Morawska & O. Simpson, eds. Nairobi, United Nations Environment Programme; Geneva, World Health Organization; Geneva, World Meteorological Organization; & Singapore, Institute of Environmental Epidemiology, WHO Collaborating Centre for Environmental Epidemiology, Ministry of the Environment (also available at www.who.int/docstore/peh/Vegetation_fires/vegetation_fires.htm).

Wotawa, G., De Geer, L-E., Becker, A., D'Amours, R., Jean, M., Servranckx, R. & Ungar, K. 2006. Inter- and intracontinental transport of radioactive cesium released by boreal forest fires. *Geophysical Research Letters*, 33: L12806, doi:10.1029/2006GL026206.

Yurganov, L.N., Duchatelet, P., Dzhola, A.V., Edwards, D.P., Hase, F., Kramer, I., Mahieu, E., Mellqvist, J., Notholt, J., Novelli, P.C., Rockmann, A., Scheel, H.E., Schneider, M., Schulz, A., Strandberg, A., Sussmann, R., Tanimoto, H., Velazco, V., Drummond, J.R. & Gille, J.C. 2004. Increased Northern Hemispheric carbonmonoxide burden in the troposphere in 2002 and 2003 detected from the ground and from space.

Atmospheric Chemistry and Physics Discussions, 4: 4999–5017.