# Emerging Methods for Early Detection of Forest Fires

## A PROJECT REPORT

*Submitted by*

**PRIYA S (19F141)**
**SHOBIKA R (19F148)**
**ATHIRA S R (19F204)**
**ROSHINI R (19F242)**

*in partial fulfillment for the award of the degree*

*of*

**BACHELOR OF TECHNOLOGY**

*in*

**INFORMATION TECHNOLOGY**


**Accredited by NAAC with 'A' Grade**

**NOVEMBER 2022**

**KARPAGAM COLLEGE OF ENGINEERING**

(AUTONOMOUS)

**COIMBATORE – 641 032**

# Emerging Methods for Early Detection of Forest Fires

**BONAFIDE RECORD OF WORK DONE BY**


**PRIYA S (19F141)**
**SHOBIKA R (19F148)**
**ATHIRA S R (19F204)**
**ROSHINI R (19F242)**


Report submitted in partial fulfillment of the requirements for the degree of

**BACHELOR OF TECHNOLOGY**

in

**INFORMATION TECHNOLOGY**

Of

Anna University, Chennai

**NOVEMBER 2022**

Faculty guide
(Mr. R. PRABHU,M.E.,)

Head of the Department
(Dr.P.MURUGESWARI,M.Tech.,Ph.D)

Certified that the candidate was examined in the viva-voce examination held on_____.

(Internal Examiner)

(External Examiner)

## ACKNOWLEDGEMENT

We express our sincere thanks to Karpagam educational and charitable trust for providing necessary facilities to bring out the project successfully. We felt greatness to record our thanks to the chairman **Dr.R.VASANTHAKUMAR, B.E.,(Hons),D.Sc.** for all his support and ray of strengthening hope extended.

It is the moment of immense pride for us to reveal our profound thanks to our respected principal, **Dr.P.VIJAYAKUMAR, M.E., Ph.D.** who happens to be striving force in all our endeavors.

We express our sincere thanks to our **Dr.P.MURUGESWARI, M.Tech., PhD.** Head of the Department of Information Technology for providing an opportunity to work on this project. His valuable suggestions helped us a lot to do this project.

A word of thanks would not be sufficient for the work of our project guide **Mr.R.PRABHU, M.E.,** Department of Information Technology whose efforts andinspiration lead us through every trying circumstance.

We would also like to recollect the courage and enthusiasm that was inculcated in us by our project coordinators **Mr.R.PRABHU, M.E.,**Department of Information Technology for valuable guidance and support through the tenure of our project.

We deeply express our gratitude to all the members of the faculty of the Department of Information Technology for the encouragement, which we received throughout the semester.

# TABLE OF CONTENTS

# Emerging Methods for Early Detection of Forest Fires


## ABSTRACT

Forests can purify water, stabilize soil, cycle nutrients, moderate climate, and store carbon. They can create habitat for wildlife and nurture environments rich in biological diversity. They can also contribute billions of dollars to the country's economic wealth. However, hundreds of millions of hectares of forests are unfortunately devastated by forest fire each year. Forest fire has been constantly threatening to ecological systems, infrastructure, and public safety. In the image processing based forest fire detection using YCbCr color model, method adopts rule based color model due to its less complexity and effectiveness. YCbCr color space effectively separates luminance from chrominance compared to other color spaces like RGB. The method not only separates fire flame pixels but also separates high temperature fire centre pixels by taking in to account of statistical parameters of fire image in YCbCr color space like mean and standard deviation. This paper presents a literature study on Image processing .

# CHAPTER 1

# INTRODUCTION

## 1.1 PROJECT 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 Video-Based 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 work is to propose deep learning techniques to predict forest fires, which would be cost-effective. The mixed learning technique is composed of Artificial intelligence (AI) are promising options to patrol the forest by making them fly over the region.

# CHAPTER 2
# LITERATURE SURVEY

## 2.1 EXISTING SYSTEM

Nowadays almost all the fire detection system uses sensors. The accuracy, reliability and positional distributions of the sensor determine the betterment of the system. For high precision fire detection systems, large numbers of sensors are needed in the case of outdoor applications. Sensors also need a frequent battery charge which is impossible in a large open space. Sensors detect fire if and only if it is close to fire. This will lead to damaging of sensor.

## 2.2 REFERENCES


**1.** A. Ollero, B. C. Arrue, and J. R. Martinez, "For reducing false alarms in forest-fires," *Computer Communications S0140366419308655–*, 2019.
View at: Publisher Site | Google Scholar

**2.**C. Yuan, Z. Liu, and Y. Zhang, "Fire Detection Using Infrared Images for UAV-Based Forest Fire Surveillance," in *Proceedings of the 2017 International Conference on Unmanned Aircraft Systems (ICUAS)*, Miami, FL, USA, June, 2017.
View at: Google Scholar

**3.**X. Wu, X. Leung, and H. Leung, "An adaptive threshold deep learning method for fire and smoke detection," in *Proceedings of the 2017 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*, pp. 1954–1959, Banff, AB, Canada, October, 2017.
View at: Publisher Site | Google Scholar

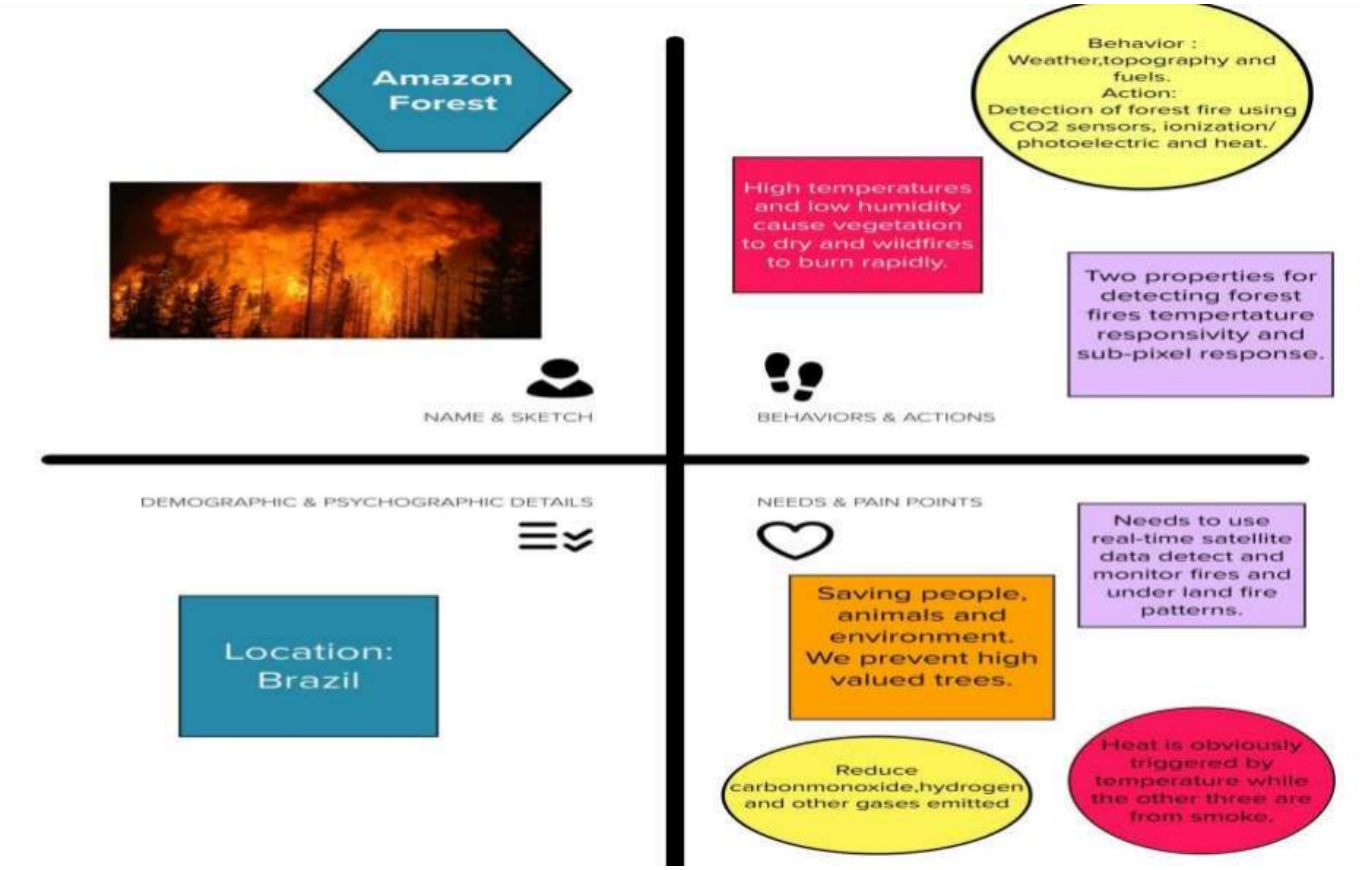

## 2.3 PROBLEM STATEMENT DEFINTION

Forest fires are occurring through out the year with an increasing intensity in the summer and autumn periods. To fight forest fires different solution where employed throughout the years. Forest fires also considered as a main contributed to the air pollution, due to the fact that during every fire huge amounts of gases and particle mater are released in the atmosphere. The simplest of these solution is the establishment of a network of observation posts both cheap and easy to accomplish, but also time-consuming for the involved people.

# CHAPTER 3

# IDEATION AND PROPOSED SOLUTION

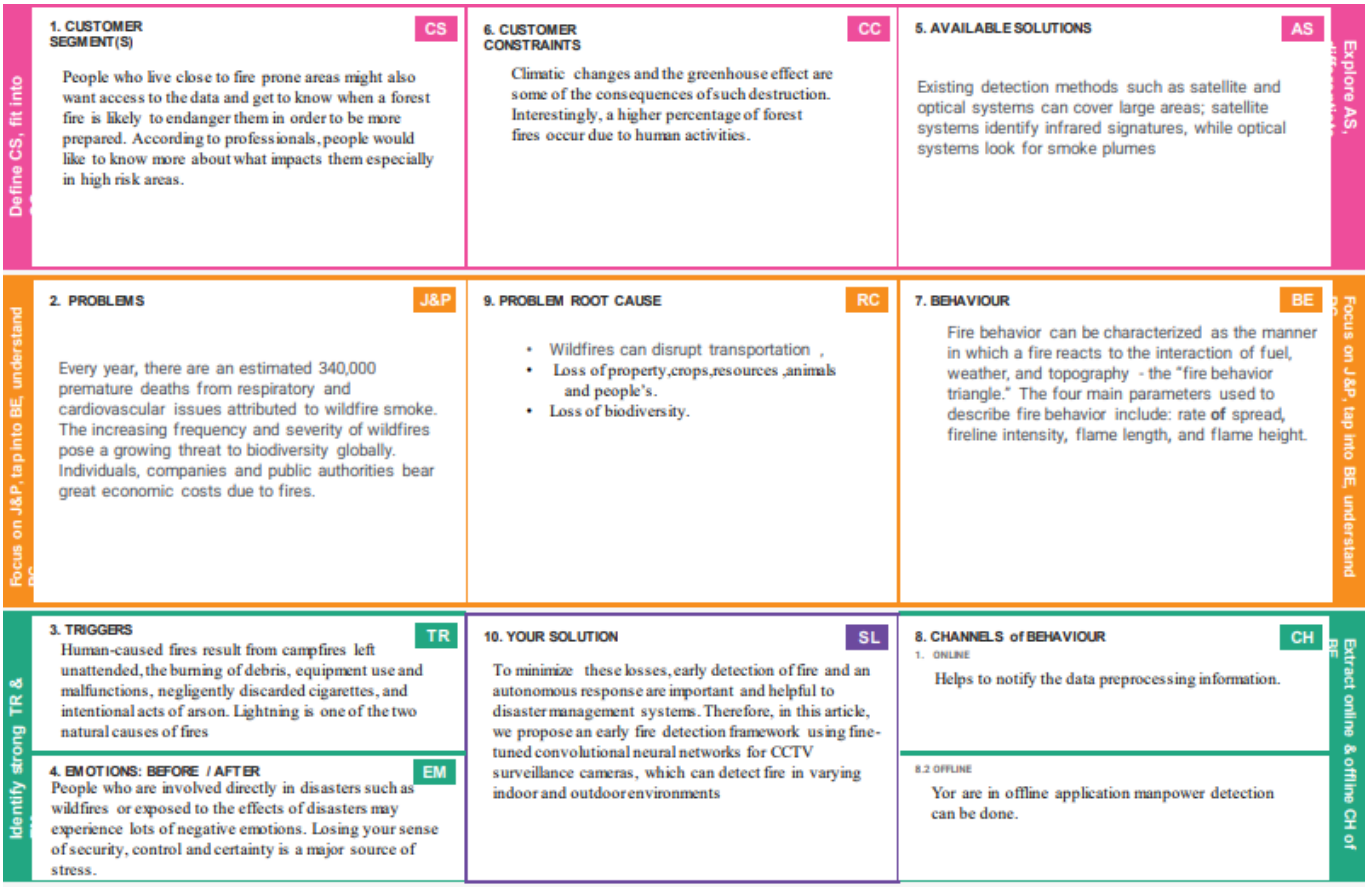
## 3.1 EMPATHY MAP CANVAS



## 3.2 PROPOSED SOLUTION

| S.NO | PARAMETER | DESCRIPTION |
|---|---|---|
| **1.** | Problem Statement (Problem to be solved). | AI based Emerging methods for early detection of forest fires. |
| **2.** | Idea / Solution description | A solution is needed that detects fires early by detecting smoke, hydrogen and other gases released by paralysis in the early stages of a wildfire, buying firefighters valuable time to extinguish the fire before it spreads out of control. Sensing solutions from Bosch Sensate can help to reduce wildfires. |
| **3.** | Novelty / Uniqueness | Remote sensing Machine learning Wildfire prediction Data mining using Artificial intelligence |
| **4.** | Social Impact / Customer Satisfaction. | The most important factors in the fight against the forest fires include the earliest possible detection of the fire event , the proper categorization of the fire and fast response from the fire services |
| **5.** | Business Model (Revenue Model) | The annual losses from forest fires in India for the entire country have been moderately estimated at Rs 440 cores (US$ 107 million). |
| **6.** | Scalability of the Solution | Aerial-based systems gained recently a lot of attention due to the rapid development of UAV technology. Such systems provide a broader and more accurate perception of the fire, even in regions that are inaccessible or considered too dangerous for fire-fighting crews. In addition, UAVs can cover wider areas and are flexible, in the sense that they monitor different areas, as needed. |

# 3.3 PROBLEM SOLUTION FIT



# CHAPTER 4
# REQUIREMENT ANALYSIS

## 4.1.Functional Requirements

These are the requirements that the end user specifically demands as basic facilities that the system should offer. All these functionalities need to be necessarily incorporated into the system as a part of the contract. These are represented or stated in the form of input to be given to the system, the operation performed and the output expected.

## 4.2.Non-Functional Requirements

These are basically the quality constraints that the system must satisfy according to the project contract. The priority or extent to which these factors are implemented varies from one project to other. They are also called non-behavioral requirements.

### Security

Security is a non-functional requirement assuring all data inside the system or its part will be protected against malware attacks or unauthorized access.

### Maintainability

A maintainable system must be capable of being maintained cost-effectively over its expected lifetime, and can incorporate additional requirements such as modifiability, configurability, extensibility and interoperability.

### Reliability

A set of specifications that describe the system's operation capabilities and constraints and attempt to improve its functionality. These are basically the requirements that outline how well it will operate including things like speed, security, reliability, data integrity, etc.

# CHAPTER 5

# PROJECT DESIGN:

## 5.1.DATA FLOW DIAGRAM

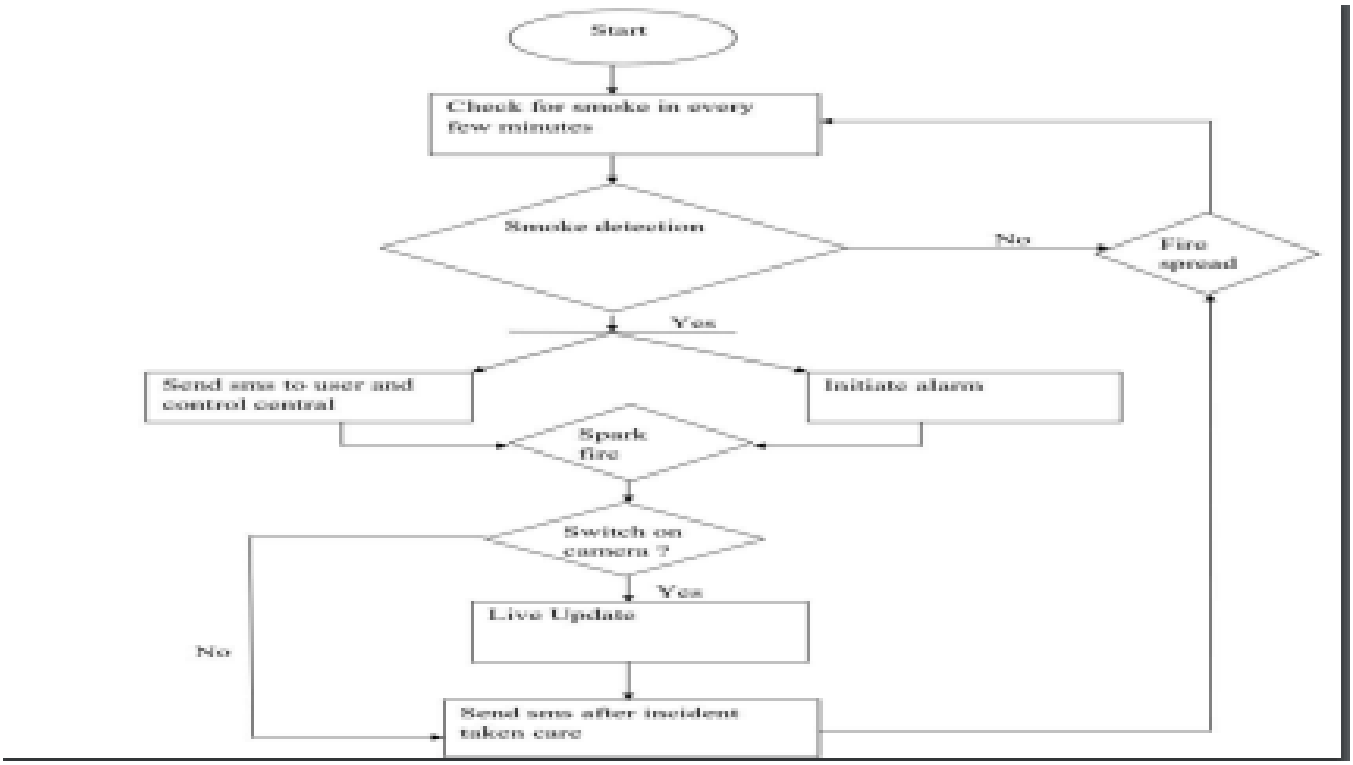
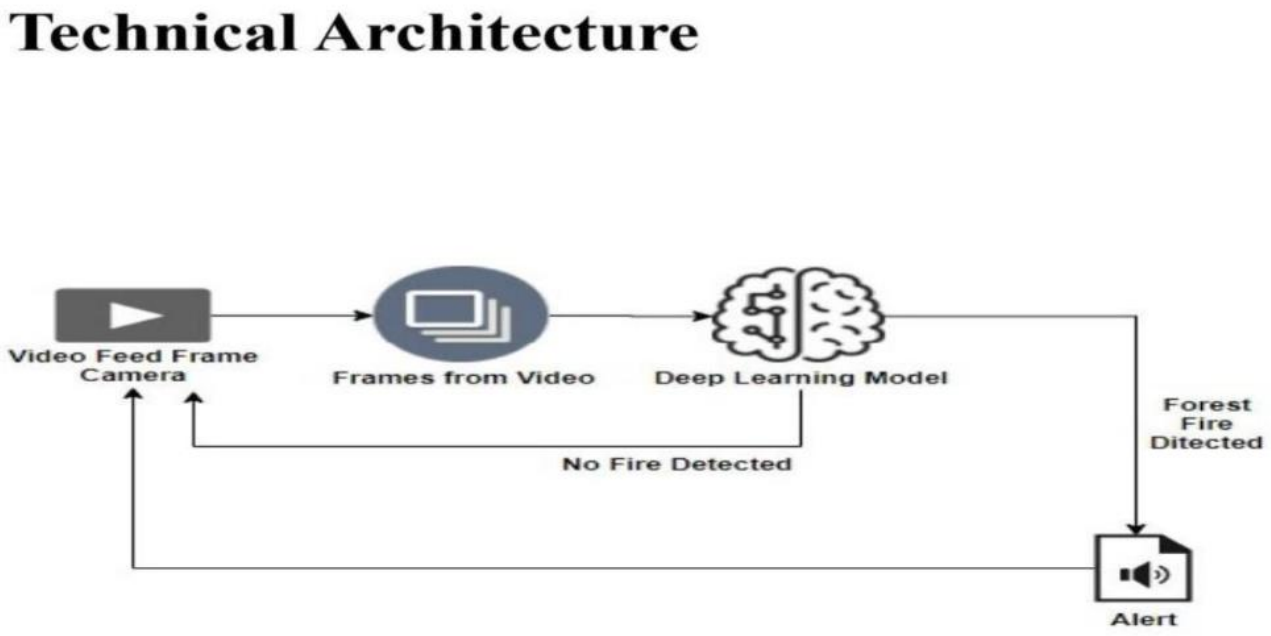



Fig.5.1 Data Flow Diagram

## 5.2.SOLUTION AND TECHNICAL ARCHITECTURE



# CHAPTER 6

# PROJECT PLANNING AND SCHEDULING

## 6.1.SPRINT PLANNING AND DELIVERY SCHEDULING

| Sprint | Functional Requirement (Epic) | User Story Number | User Story / Task | Story Points | Priority | Team Members |
|---|---|---|---|---|---|---|
| Sprint-1 | Registration | USN-1 | As an user, I can register for the application by entering my email, password, and confirming my password. | 2 | High | Shobika R |
| Sprint-1 | User Confirmation | USN-2 | As an user, I will receive confirmation email once I have registered for the application | 1 | Medium | Shobika R |
| Sprint-1 | Login | USN-3 | As an user, I can log into the application by entering email & password | 2 | High | Shobika R |
| Sprint-2 | Data Collection | USN-1 | Download the dataset used in Digital Naturalist – AI Enabled tools for Biodiversity Researchers | 2 | High | Roshini R |
| Sprint-2 | Image Preprocessing | USN-1 | Improving the image data that suppresses unwilling distortions or enhances some image features important for further processing, although performing some geometric transformations of images like rotation, scaling, etc. | 1 | High | Roshini R |
| Sprint-3 | Getting started with Convolutional Neural Network | USN-1 | Neural network are integral for teaching computers to think and learn by classifying information, similar to how we as humans learn. With neural networks, the software can learn to recognize images, for example. Machines can also make predictions and decisions with a high level of accuracy based on data inputs. | 2 | High | Priya S |
| Sprint-3 | Evaluation and model saving | USN-1 | well a model behaves after each iteration of optimization. An accuracy metric is used to measure the algorithm's performance in an interpretable way. The accuracy of a model is usually determined after the model parameters and is calculated in the form of a percentage. Saving The Model get_weights , set_weights . | 1 | Medium | Priya S<br>Athira S R |
| Sprint-4 | Application Building | USN-2 | After the model is built, we will be integrating it to a web application so that normal users can also use it. The users need to give the images of species | 1 | High | Priya S |
| Sprint-4 | Train the Model on IBM | USN-3 | Build Deep learning model and computer vision Using the IBM cloud. | 2 | High | Priya S |

# CHAPTER 7

# CODING AND SOLUTIONING

## 7.1.FEATURE 1

INDEX.PHP

```
<?php
session_start();          if (isset($_SESSION['SESSION_EMAIL'])) {
header("Location: welcome.php");die();
}
include 'config.php';
$msg = "";

if (isset($_GET['verification'])) {
if (mysqli_num_rows(mysqli_query($conn, "SELECT * FROM users WHERE code='{$_GET['verification']}'")) > 0) {
$query = mysqli_query($conn, "UPDATE users SET code='' WHERE code='{$_GET['verification']}'");

if ($query) {
$msg = "<div class='alert alert-success'>Account verification has been successfully completed.</div>";
}
} else {
header("Location: index.php");
}
}

if (isset($_POST['submit'])) {
$email = mysqli_real_escape_string($conn, $_POST['email']);
$password = mysqli_real_escape_string($conn, md5($_POST['password']));

$sql = "SELECT * FROM users WHERE email='{$email}' AND password='{$password}'";
$result = mysqli_query($conn, $sql);

<!DOCTYPE html>
<html lang="zxx">

<head>
<title>Forest fire detection</title>
<!-- Meta tag Keywords -->
<meta name="viewport" content="width=device-width, initial-scale=1">
<meta charset="UTF-8" />
<meta name="keywords" content="Login Form" /> <!--
//Meta tag Keywords -->

<link href="//fonts.googleapis.com/css2?family=Poppins:wght@300;400;500;600&display=swap">
```

REGISTER.PHP:

```
<!DOCTYPE html>
<html lang="zxx">
<head>
<title>Forest fire detection</title>
<!-- Meta tag Keywords -->
<meta name="viewport" content="width=device-width, initial-scale=1">
<meta charset="UTF-8" />
<meta name="keywords"content="Login Form" />
<!-- //Meta tag Keywords -->
<body>
<!-- form section start -->
<section class="w3l-mockup-form">
<div class="container">
<!-- /form -->
<div class="workinghny-form-grid">
<div class="main-mockup">
<div class="alert-close">
<span class="fa fa-close"></span>
</div>
<div class="w3l_form align-self">
<div class="left_grid_info">
<img src="reg1.jpeg" alt="">
</div>
</div>
<div class="content-wthree">
<h2>Register Now</h2>
```

WELCOME.PHP

```
<?php
session_start();          if
(!isset($_SESSION['SESSION_EMAIL']))   {
header("Location: index.php");
die();
```

```
}
include 'config.php';

$query =mysqli_query($conn,"SELECT * FROM users WHERE email='{$_SESSION['SESSION_EMAIL']}'");

if (mysqli_num_rows($query) > 0) {

$row = mysqli_fetch_assoc($query);

echo "Welcome " . $row['name'] . " <a href='logout.php'>Logout</a>";

}
?>
```

LOGOUT.PHP

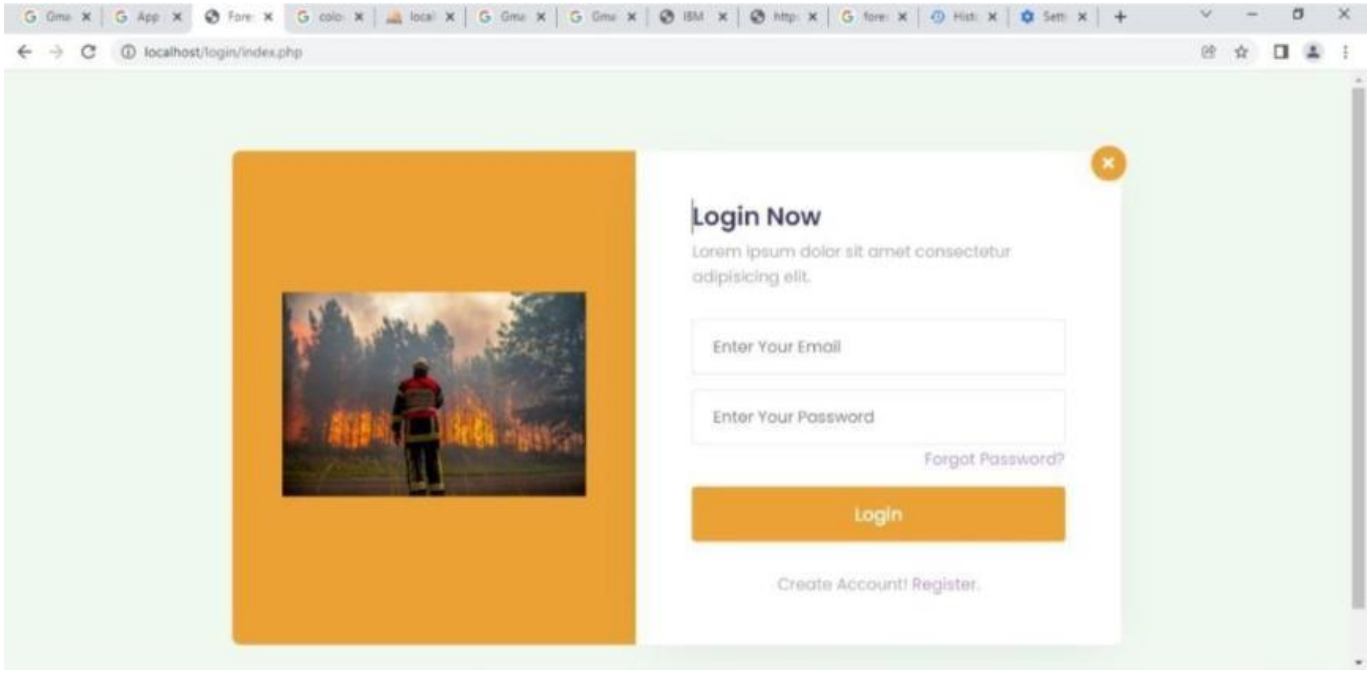
```
<?php
session_start();
session_unset();
session_destroy();
header("Location: index.php");
?>
```

# CHAPTER 8

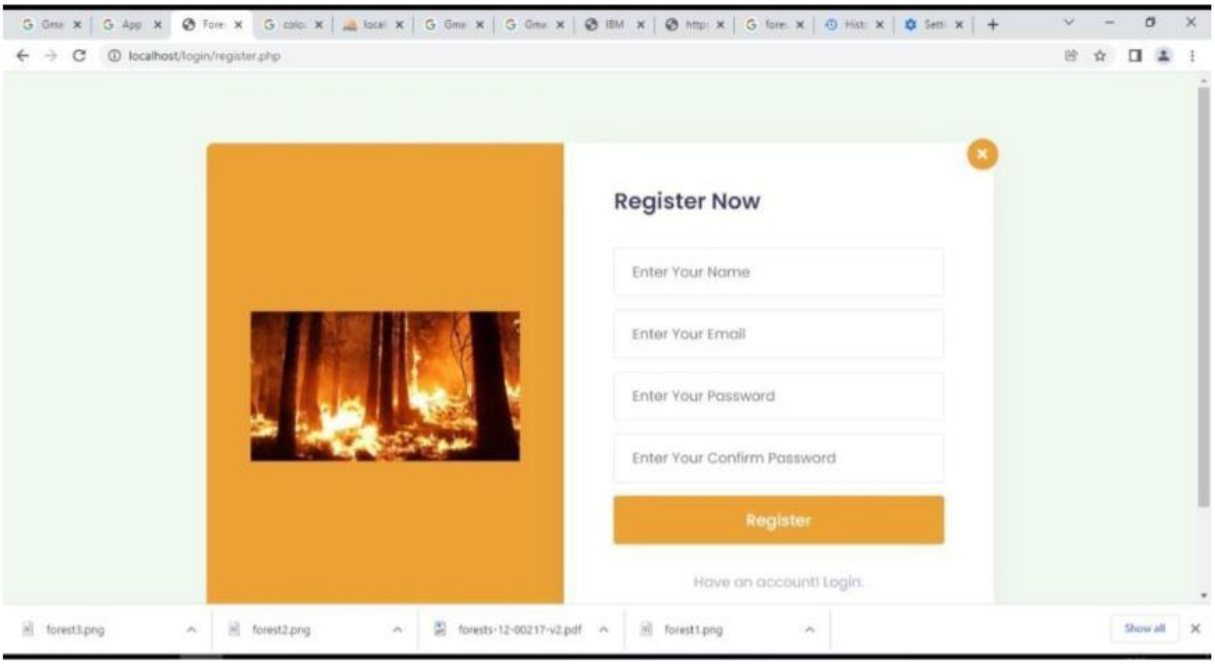
# TESTING

## 8.1 TEST CASES

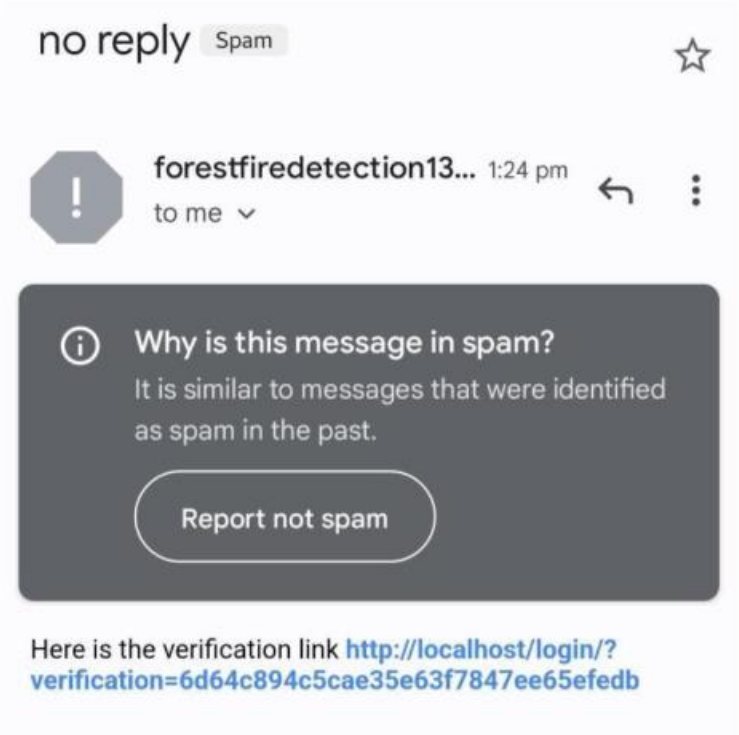
## LOGIN PAGE



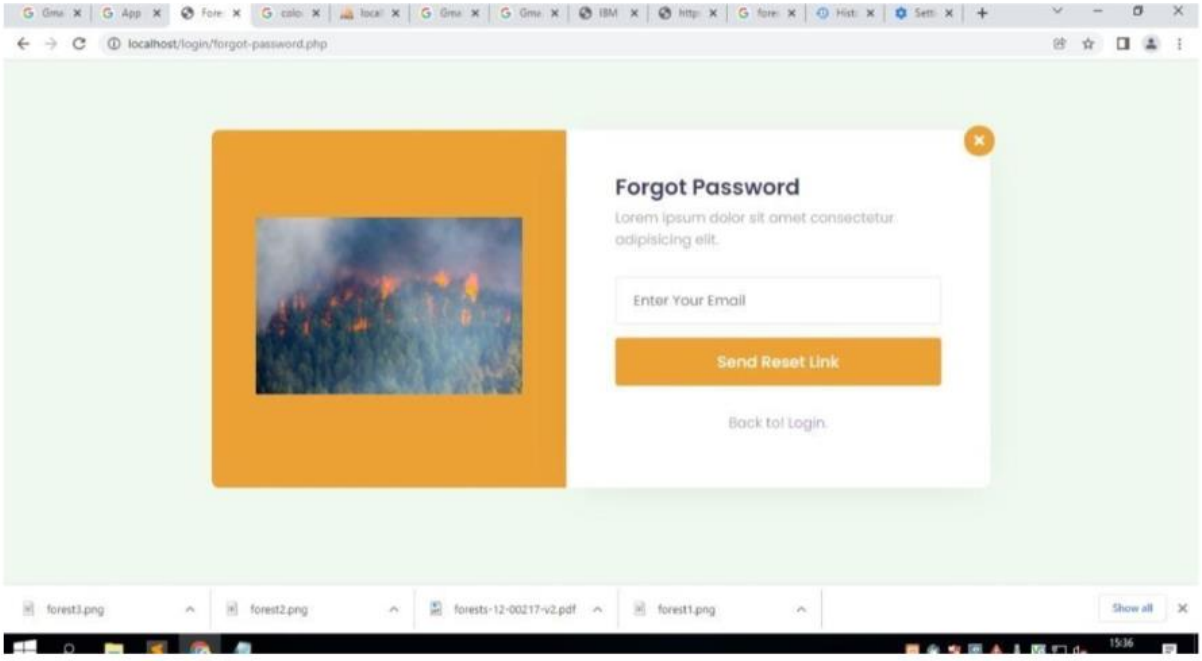

**RegisterPage**



## User Confirmation




## Forget Password

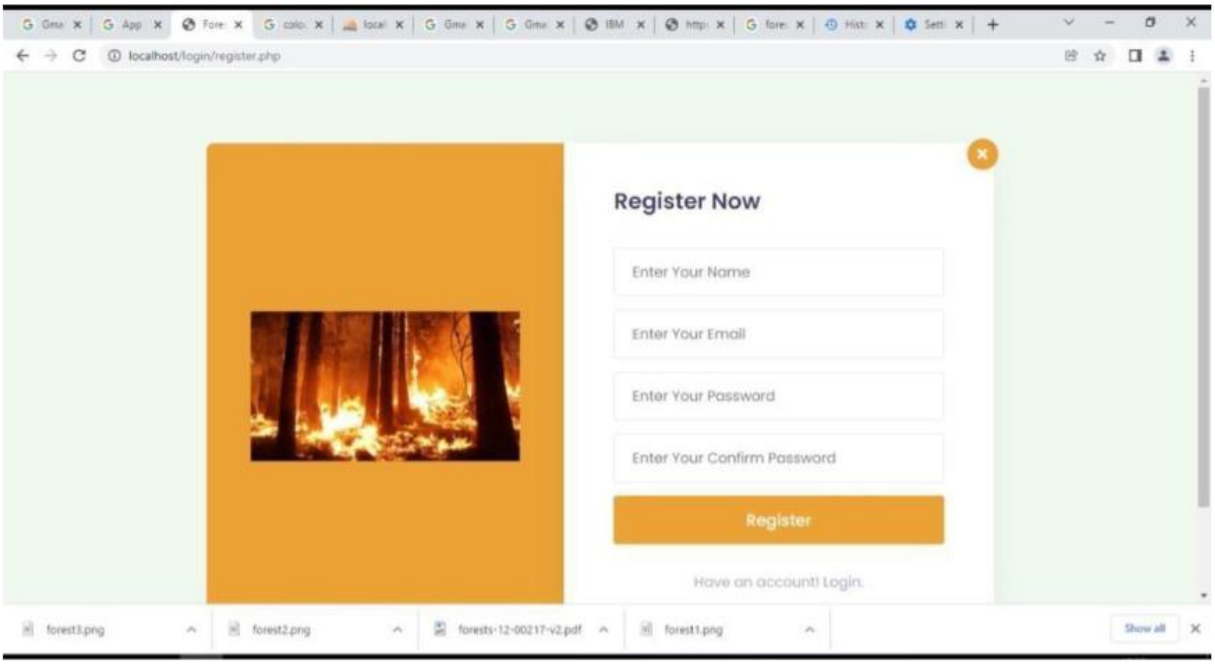


# CHAPTER 9

# RESULTS

## 9.1 PERFORMANCE METRICS

**RegisterPage**



# CHAPTER 10

## ADVANTAGES AND DISADVANTAGES

Every year it seems like there's another disastrous wildfire in the American West. In 2018, nearly 9 million acres were burned in the US alone. Uncontrolled fires often started accidentally by people, rampage and decimate forests. For most people, a forest fire is synonymous with disaster. But there are some kinds of forest fires that actually benefit the environment.

From forests to deserts, wildfires affect air quality, vegetation, human and animal habitats, and climate around the world. Fire managers and researchers are finding ways to use NASA data to battle fires and measure their effects. Burning fires produce both ashes, which falls to the ground like snow but can also get caught up in winds, and smoke, a mixture of gases and particulate matter. These get into the atmosphere and can travel long distances impacting air quality regionally. Wildfires are unplanned fires that start in forests or wild land areas. There are numerous post-fire impacts, including an increase in air pollution and less infiltration of precipitation, contributing to flooding hazards even long after the burn.
A controlled burn is a wildfire that people set intentionally for a specific purpose. Well-thought-out and well-managed controlled burns can be incredibly beneficial for forest management, in part because they can help stop an out-of-control wildfire. The technique is called back burning, and it involves setting a controlled fire in the path of the approaching wildfire. All the flammable material is burnt up and extinguished. When the wildfire approaches, there's no more fuel left for it to keep going, and it dies out. Forest fire science entails understanding how a fire starts, what contributes to the fire and how the fire might impact future Earth processes. Understanding climatologically changes are important to understand how these changes may contribute to fires in the future.

Controlled burns are also used to prevent forest fires. Even before human involvement, natural, low-intensity wildfires occurred every few years to burn up fuel, plant debris, and dead trees, making way for young, healthy trees and vegetation to thrive. That new growth in turn supports forest wildlife. Forest managers are now replicating this natural strategy when appropriate, starting manageable, slow-burning fires to make room for the new life that will help keep the forest healthy in the long term.

The same method is one of WWF's strategies for maintaining grassland habitats in the Northern Great Plains. Working with partners such as the U.S. Fish and Wildlife Service, WWF has intentionally burned hundreds of acres of prairie land to revitalize these key habitats. The fire burns off tall, aggressive vegetation that isn't as hospitable to wildlife, and makes room for new growth that attracts bison, birds, and prairie dogs.

This doesn't mean all intentional wildfires are good. Many of the fires intentionally set for agriculture and land clearing are at best ill-advised, and at worst devastating. Slash and burn fires are set every day to destroy large sections of forests. Of course, these forests don't just remove trees; they kill and displace wildlife, alter water cycles and soil fertility, and endanger the lives and livelihoods of local communities. They also can rage out of control. In 1997, fires set intentionally to clear forests in Indonesia escalated into one of the largest wildfires in recorded history. Hundreds of people died; millions of acres burned; already at-risk species like orangutans perished by the hundreds; and a smoke and ash haze hung over Southeast Asia for months, reducing visibility and causing acute health conditions.

# CHAPTER 11

# CONCLUSION

The proposed system for forest fire detection using wireless sensor networks and machine learning was found to be an effective method for fire detection in forests that provides more accurate results. Here, to obtain a more accurate outcome within the lowest latency, the analysis takes place within both the sensor node and at the base station. For the system, to fit any weather condition, climatic condition, or area, a threshold ratio is introduced for analysis within the sensor node. In the case of node deployment, it can be mounted at any place in the forest even if there is no preinstalled network connectivity, as the transceiver module is based on dedicated built-in network infrastructure. Because of the primary power supply provided by rechargeable batteries with a secondary solar power supply, a solution is readily implementable as a standalone system for prolonged periods. The proposed system incorporated with the communication infrastructure alerted the relevant authorities with lower latency than the existing systems during the numerous test trials conducted in real tropical forest sites.

# FUTURE SCOPE

The scope of using video frames in the detection of fire using machine learning is challenging as well as innovative. If the system with less error rate can be implemented at a large scale like in big factories , houses , forests ,it is possible to prevent damage and loss due to random fire accidents by making use of the surveillance systems.