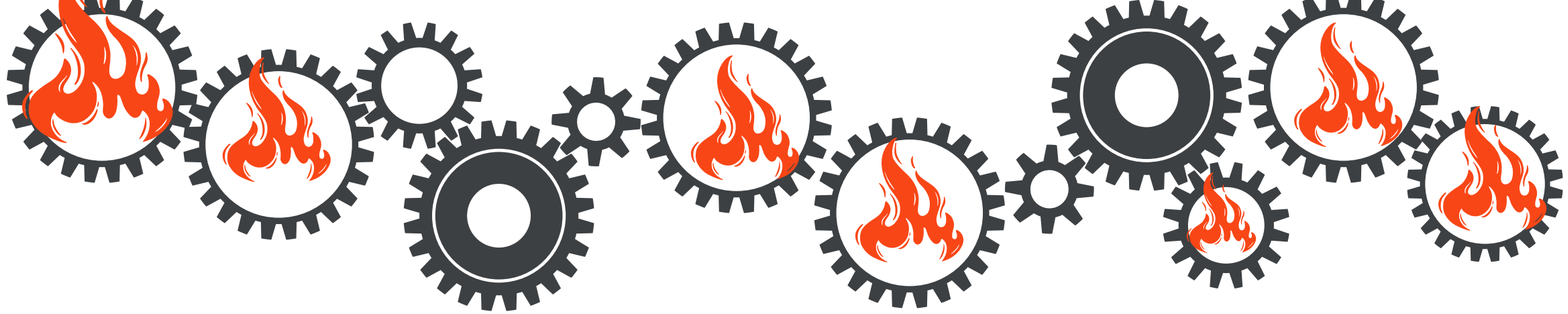
INTELLIGENT FIRE DETECTION AND RESPONSE SYSTEM WITH DYNAMIC NOZZLE CONTROL AND EVACUATION PLANNING

PROPOSAL PRESENTATION

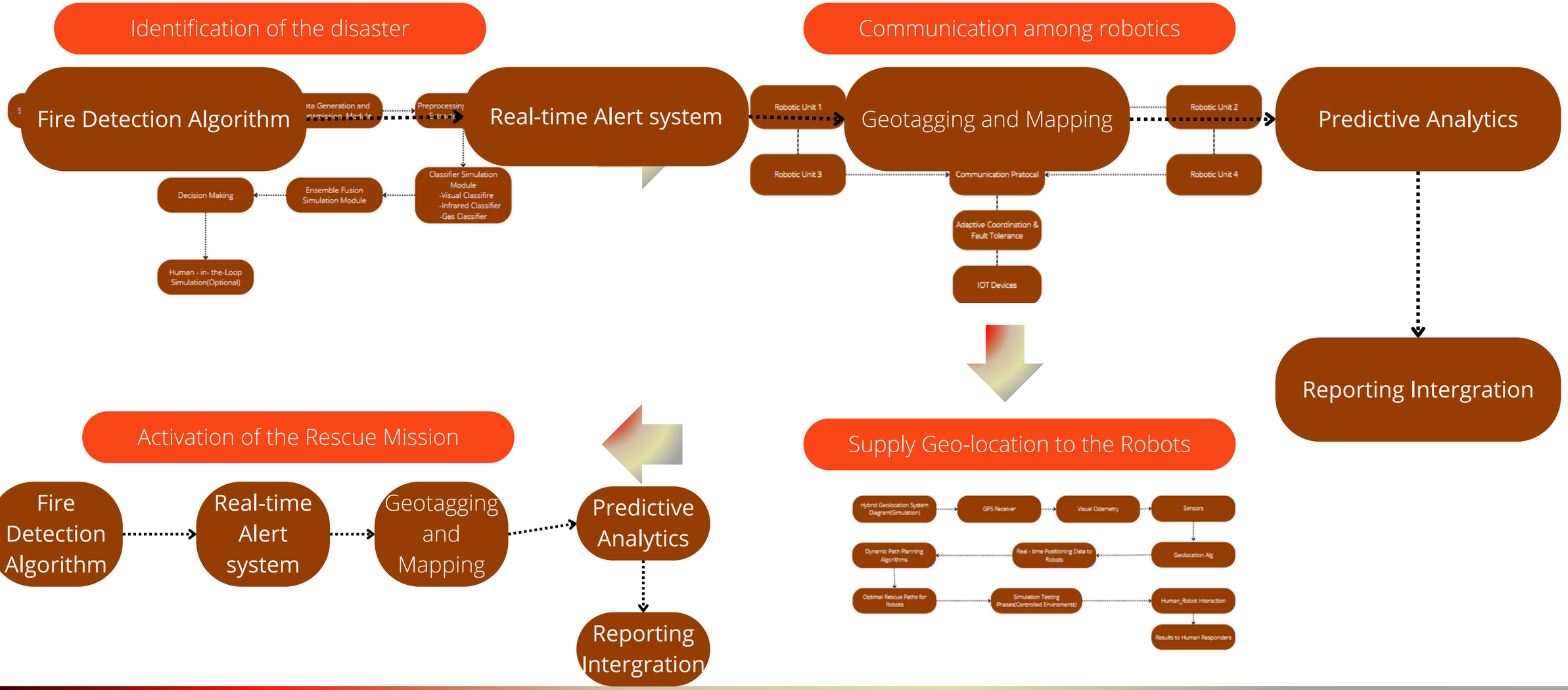
R24-098



INTRODUCTION

Introducing our Dynamic Fire Response System, a cutting-edge solution that redefines fire management. Incorporating advanced fire detection technology, encrypted communication, and dynamic nozzle control, it swiftly identifies flames and optimizes water dispersal for efficient suppression. Beyond firefighting, it employs intelligent communication to relay crucial information and maps out optimal evacuation routes, ensuring swift and safe egress from affected areas. By integrating detection, communication, fire control, and evacuation planning, our system sets a new standard in fire management, prioritizing safety and efficiency in emergencies.

System Oveview Diagram



Technologies

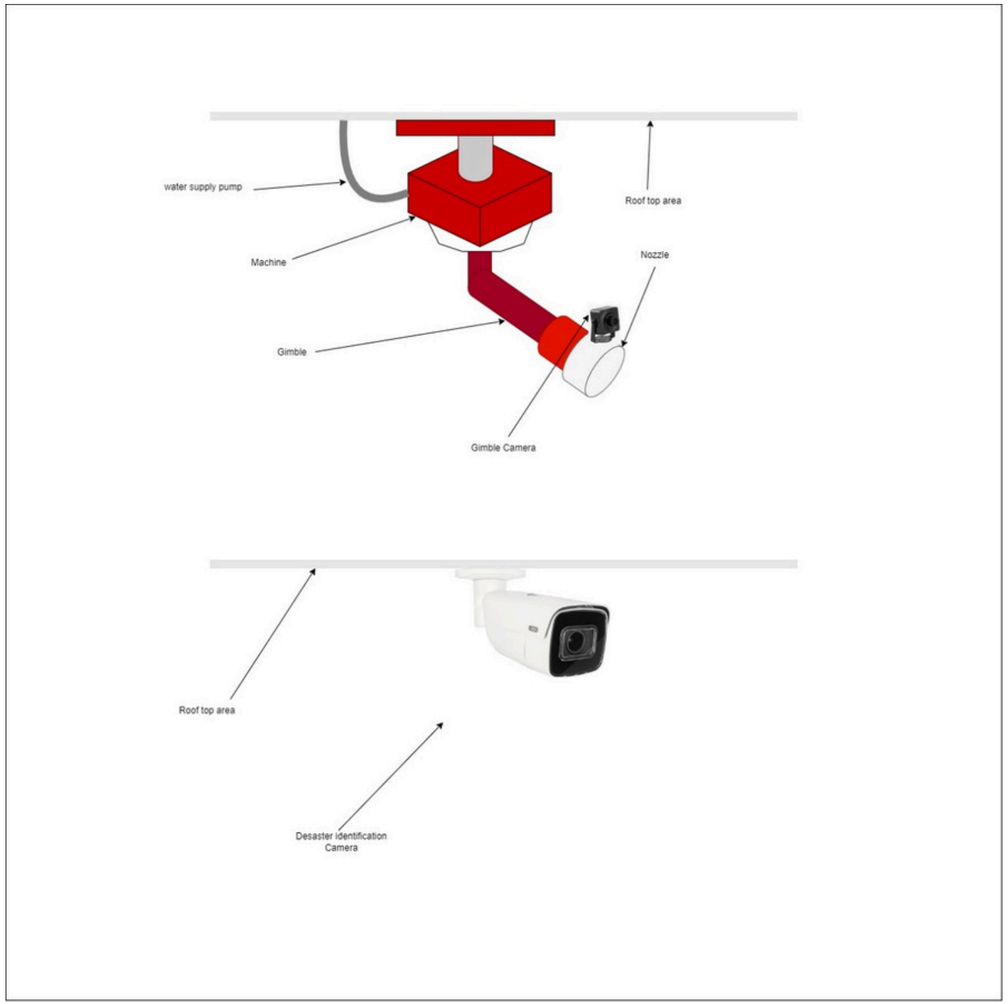
ML

Python

Arduino

MongoDB

IOT



Research Questions

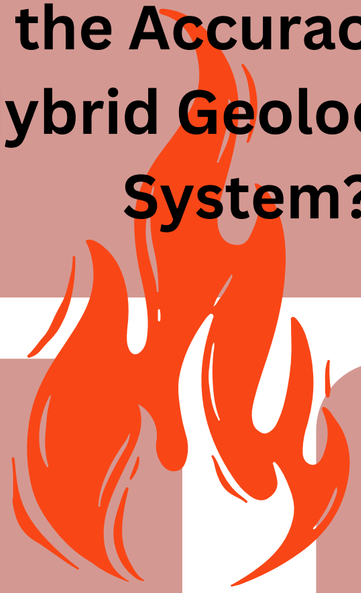
How can Optimize Decentralized Communication Protocol?

How to enhance the Accuracy of Hybrid Geolocation System?

Way of Improving Real-Time Disaster Identification.

Adaptive Activation Algorithm Optimization

Integration and Interoperability Challenges.



Objectives

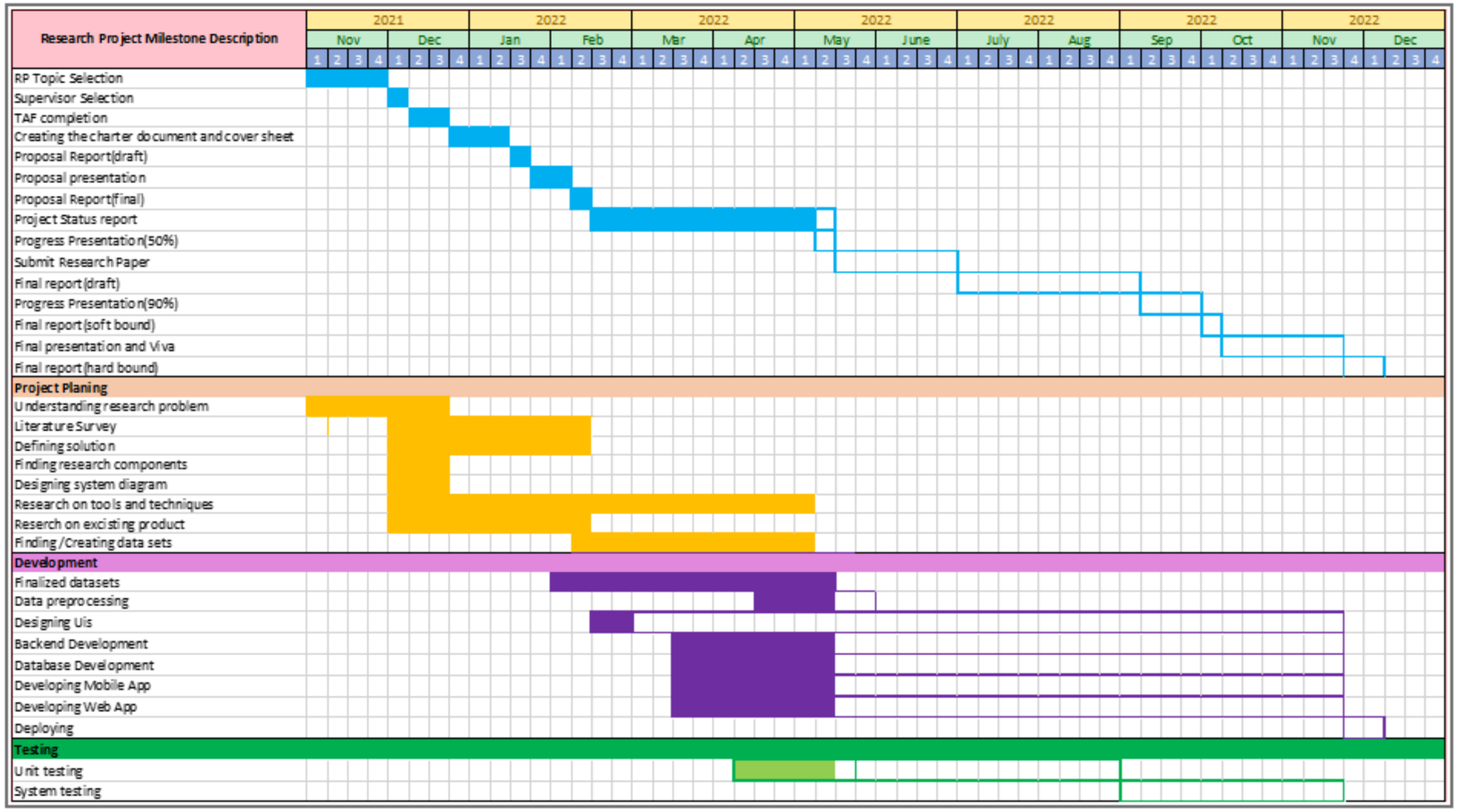
01 Developing Robust Communication Protocols

02 Enhancing Geolocation Systems

03 Implementing Disaster Detection Systems

04 Adapting Activation Algorithms

TIMELINE


Research Project Milestone Description
2021
2022
Nov
Dec
Jan
Feb
Mar
Apr
May
June
July
Aug
Sep
Oct
Nov
Dec
RP Topic Selection
Supervisor Selection
TAF completion
Creating the charter document and cover sheet
Proposal Report(draft)
Proposal presentation
Proposal Report(final)
Project Status report
Progress Presentation(50%)
Submit Research Paper
Final report(draft)
Progress Presentation(90%)
Final report(soft bound)
Final presentation and Viva
Final report(hard bound)
Project Planing
Understanding research problem
Literature Survey
Defining solution
Finding research components
Designing system diagram
Research on tools and techniques
Reserch on excisting product
Finding /Creating data sets
Development
Finalized datasets
Data preprocessing
Designing Uis
Backend Development
Database Development
Developing Mobile App
Developing Web App
Deploying
Testing
Unit testing
System testing

Sachintha Gayashan W.K

IT20154462

Specialization : Information Technology

Communication system

BACKGROUND

- In a fire suppression system, the efficient extinguishing of fires relies on accurate detection of the fire, followed by timely and precise water discharge from a nozzle. This process involves encoding the detection signal for transmission to an Arduino board, where it is decoded and used to control the nozzle's operation. The key challenge lies in determining the appropriate flow rate of water, the distance at which it should be sprayed, and the speed at which the nozzle should be operated to effectively extinguish the fire while conserving water and minimizing damage.

- How many cubic meters of water per second should be released from the nozzle to extinguish the fire? It is calculated how far and how fast it should be pressed and how much the nozzle should be opened for that.

RESEARCH QUESTION

How many cubic meters of water per second should be released from the nozzle to extinguish the fire? It is calculated how far and how fast it should be pressed and how much the nozzle should be opened for that.

RESEARCH GAP

Despite advancements in fire detection and suppression technologies, there remains a significant gap in integrating real-time data analytics and adaptive control mechanisms into firefighting systems. Existing approaches often lack the capability to dynamically adjust water discharge rates, pressure levels, and nozzle configurations based on evolving fire dynamics and environmental factors. Bridging this gap requires innovative solutions that leverage data-driven insights to optimize firefighting efficiency, minimize resource wastage, and enhance overall fire safety

SPECIFIC AND SUB OBJECTIVE

Develop an Integrated Fire Tracking and Water Discharge System

Develop an Integrated Fire Tracking and Water Discharge System

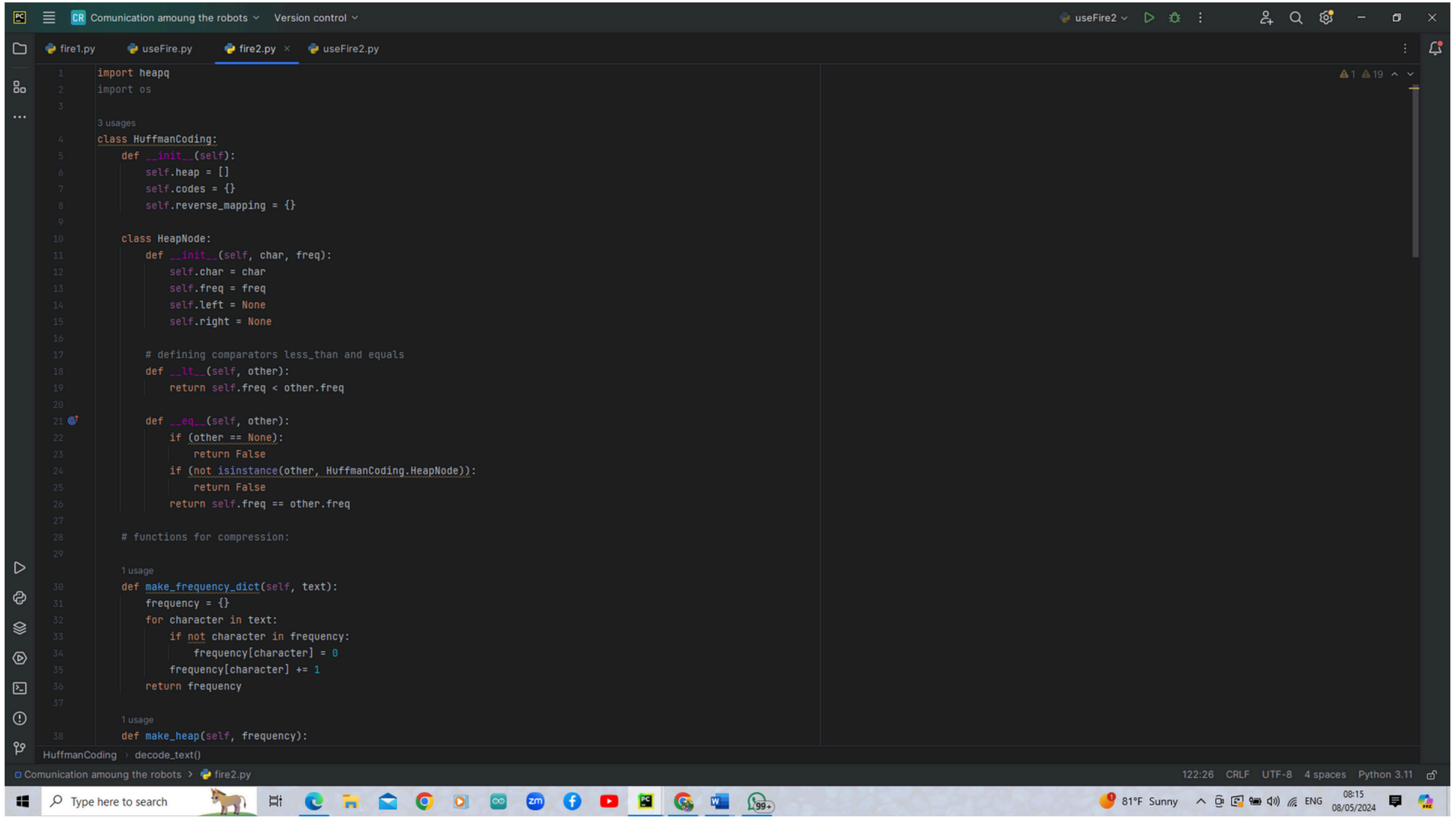
SPECIFIC AND SUB OBJECTIVE

Sub objectives

- Develop real-time fire detection and tracking algorithms for integration into the system.
- Design an efficient data encoding method to compress tracked fire data for transmission and implement a decoding mechanism on the Arduino board.
- Conduct empirical studies to determine the required water flow rate based on fire size and intensity.
- Develop algorithms to calculate optimal nozzle opening based on fire distance and size and implement control logic for adjusting nozzle pressure and angle.

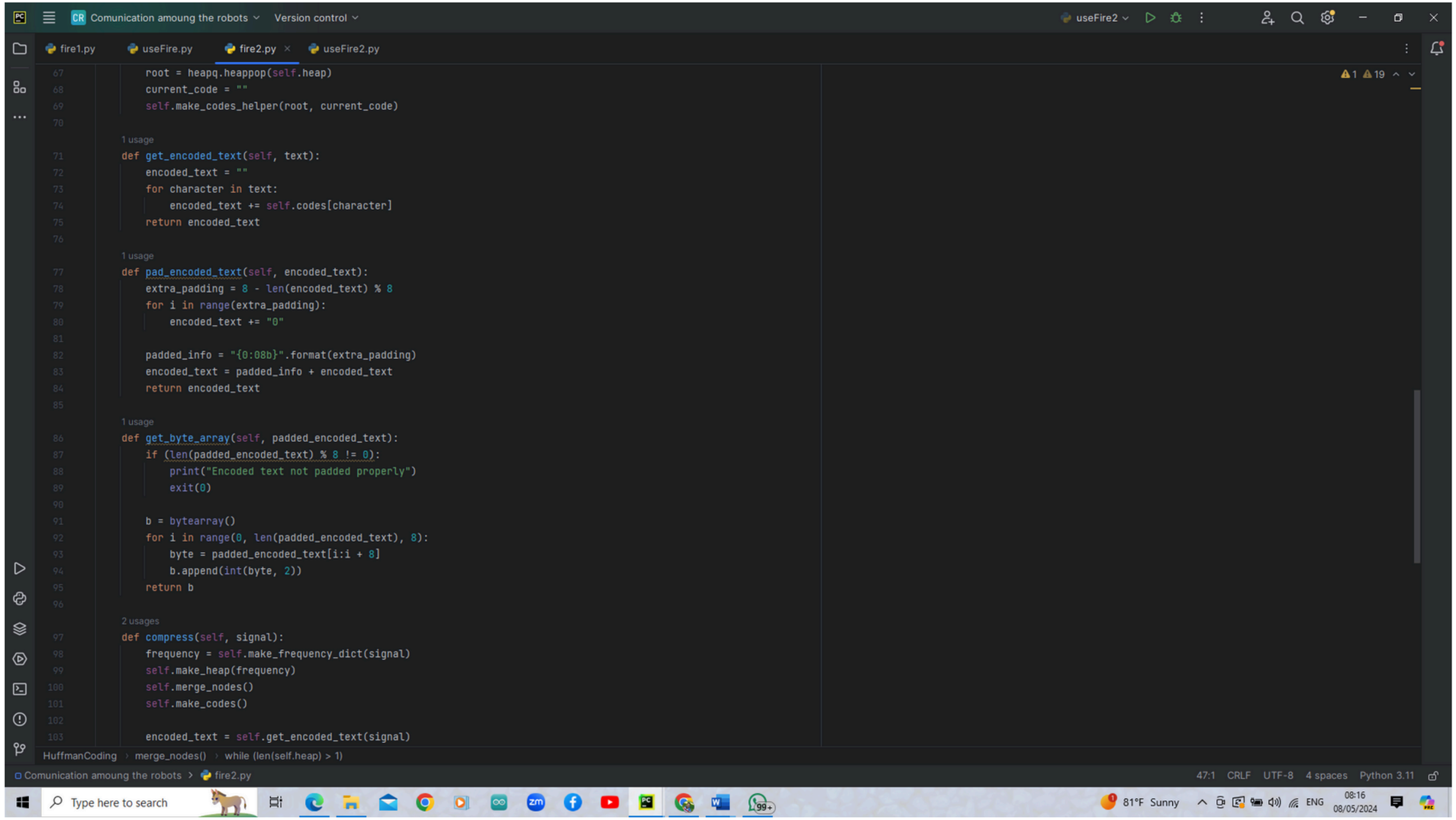
SYSTEM DIAGRAM

The part that encodes the signal coming through the fire tracking system

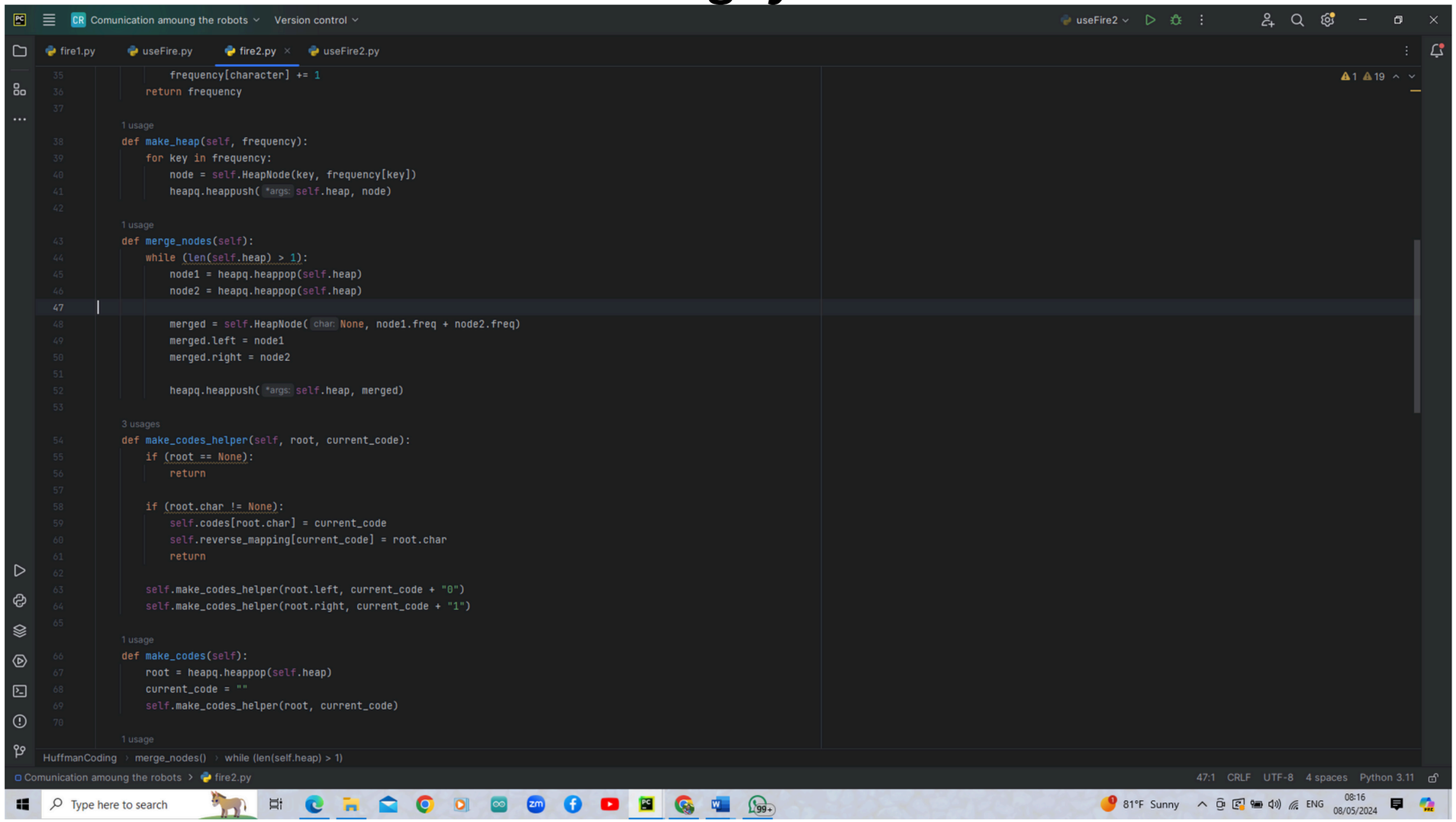


```
import heapq
import os

3 usages
class HuffmanCoding:
    def __init__(self):
        self.heap = []
        self.codes = {}
        self.reverse_mapping = {}

    class HeapNode:
        def __init__(self, char, freq):
            self.char = char
            self.freq = freq
            self.left = None
            self.right = None

        # defining comparators less_than and equals
        def __lt__(self, other):
            return self.freq < other.freq

        def __eq__(self, other):
            if (other == None):
                return False
            if (not isinstance(other, HuffmanCoding.HeapNode)):
                return False
            return self.freq == other.freq

    # functions for compression:

    1 usage
    def make_frequency_dict(self, text):
        frequency = {}
        for character in text:
            if not character in frequency:
                frequency[character] = 0
            frequency[character] += 1
        return frequency

    1 usage
    def make_heap(self, frequency):
```

The part that encodes the signal coming through the fire tracking system



The part that encodes the signal coming through the fire tracking system



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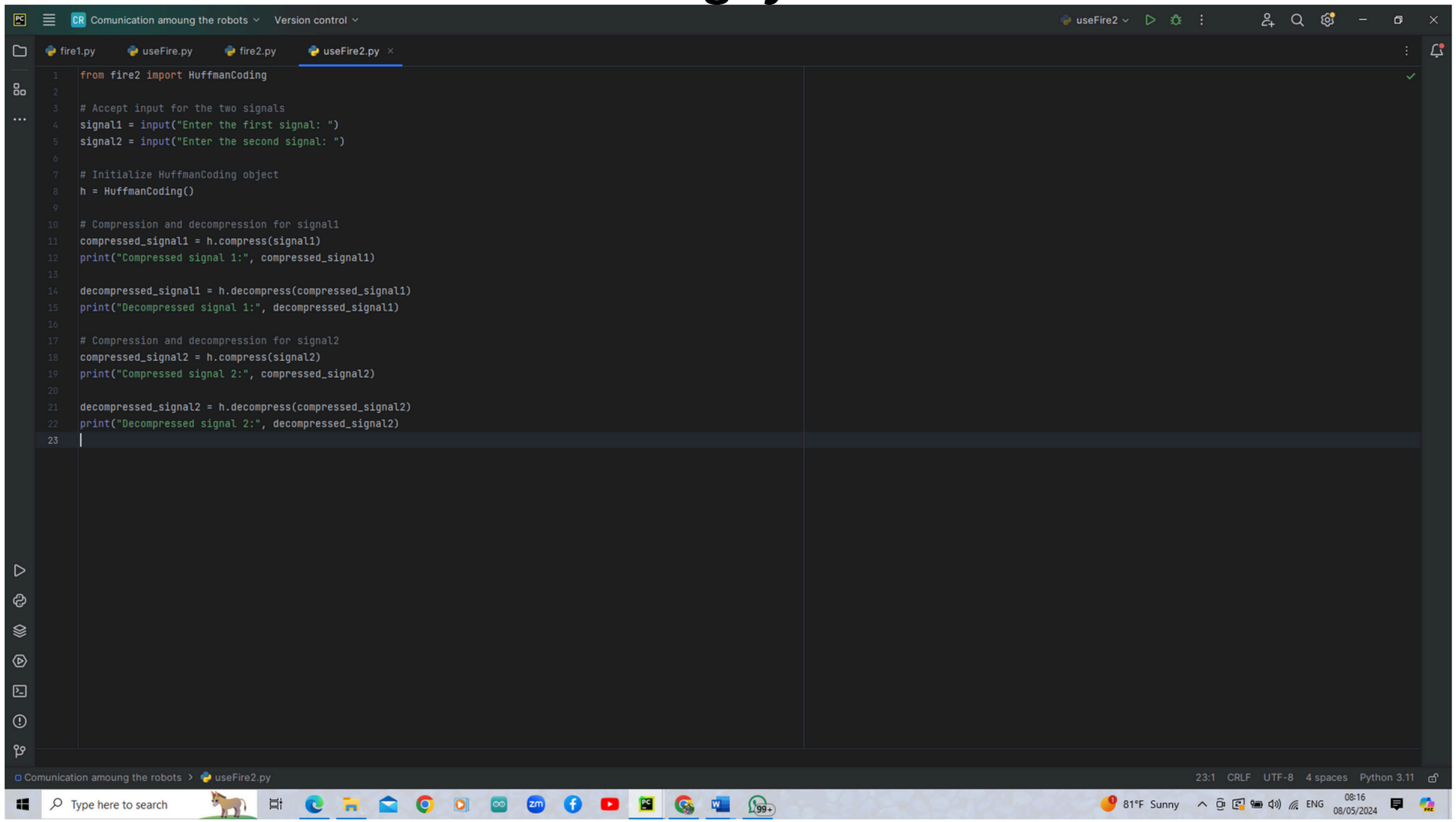

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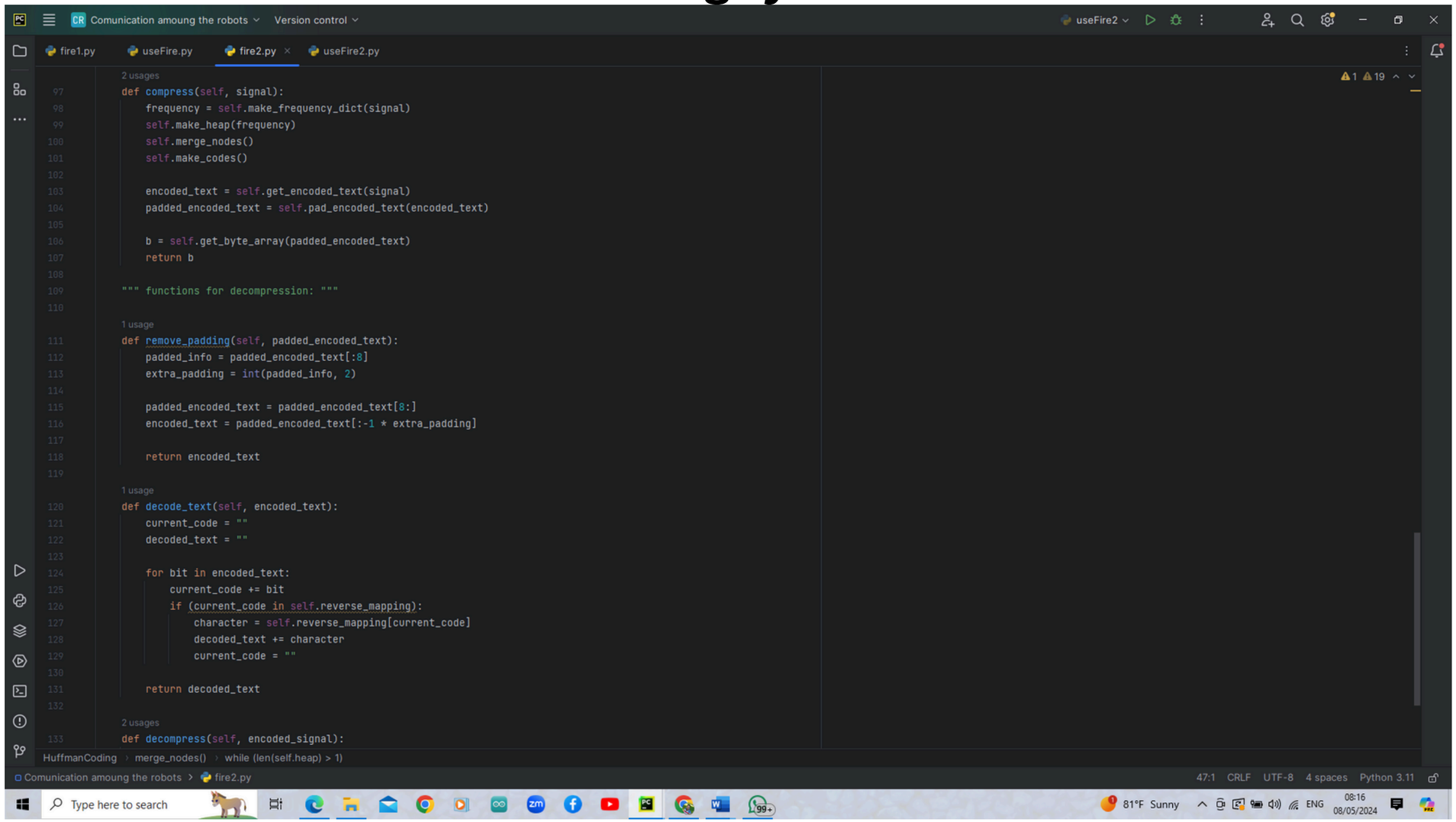

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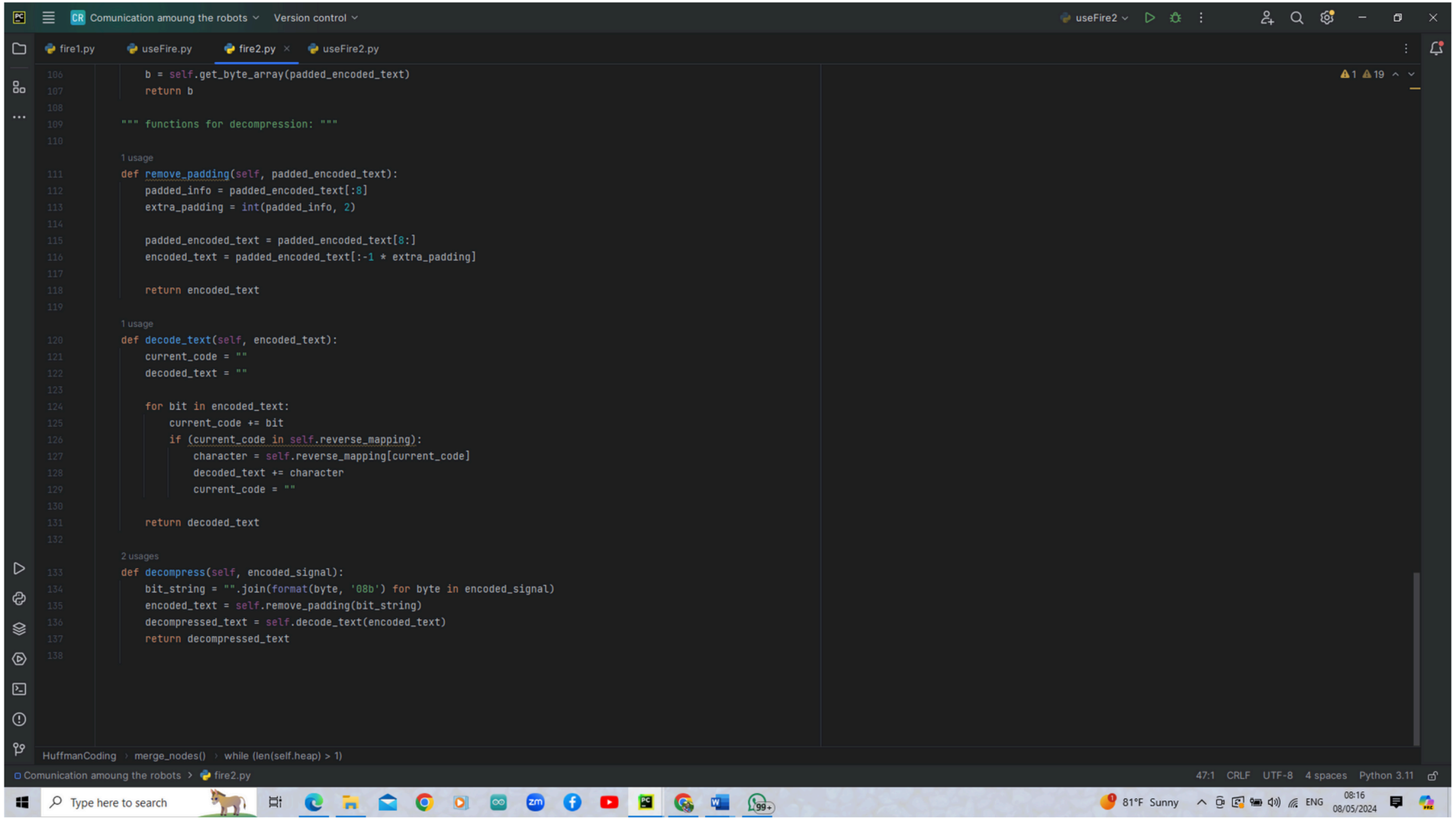
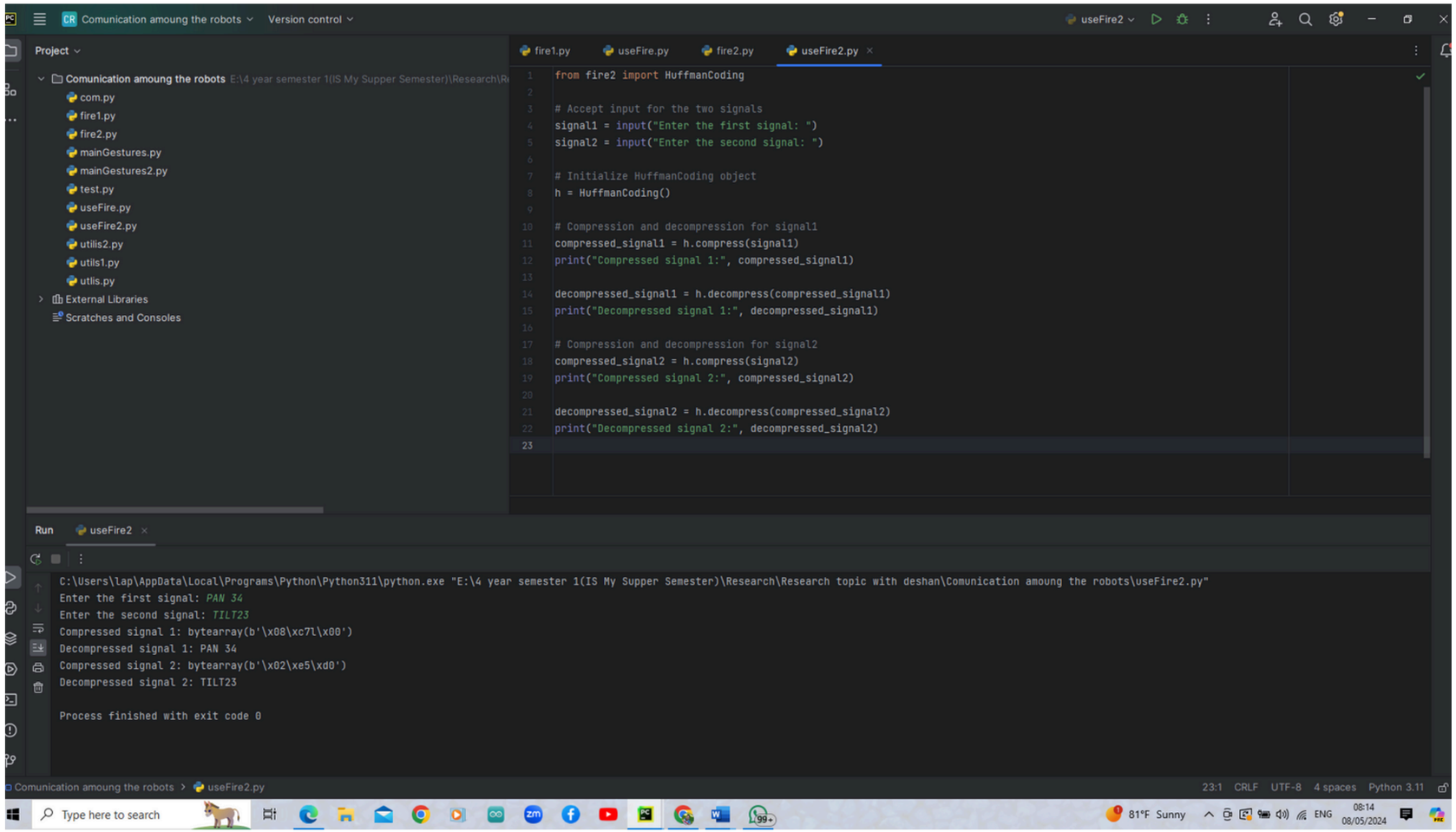
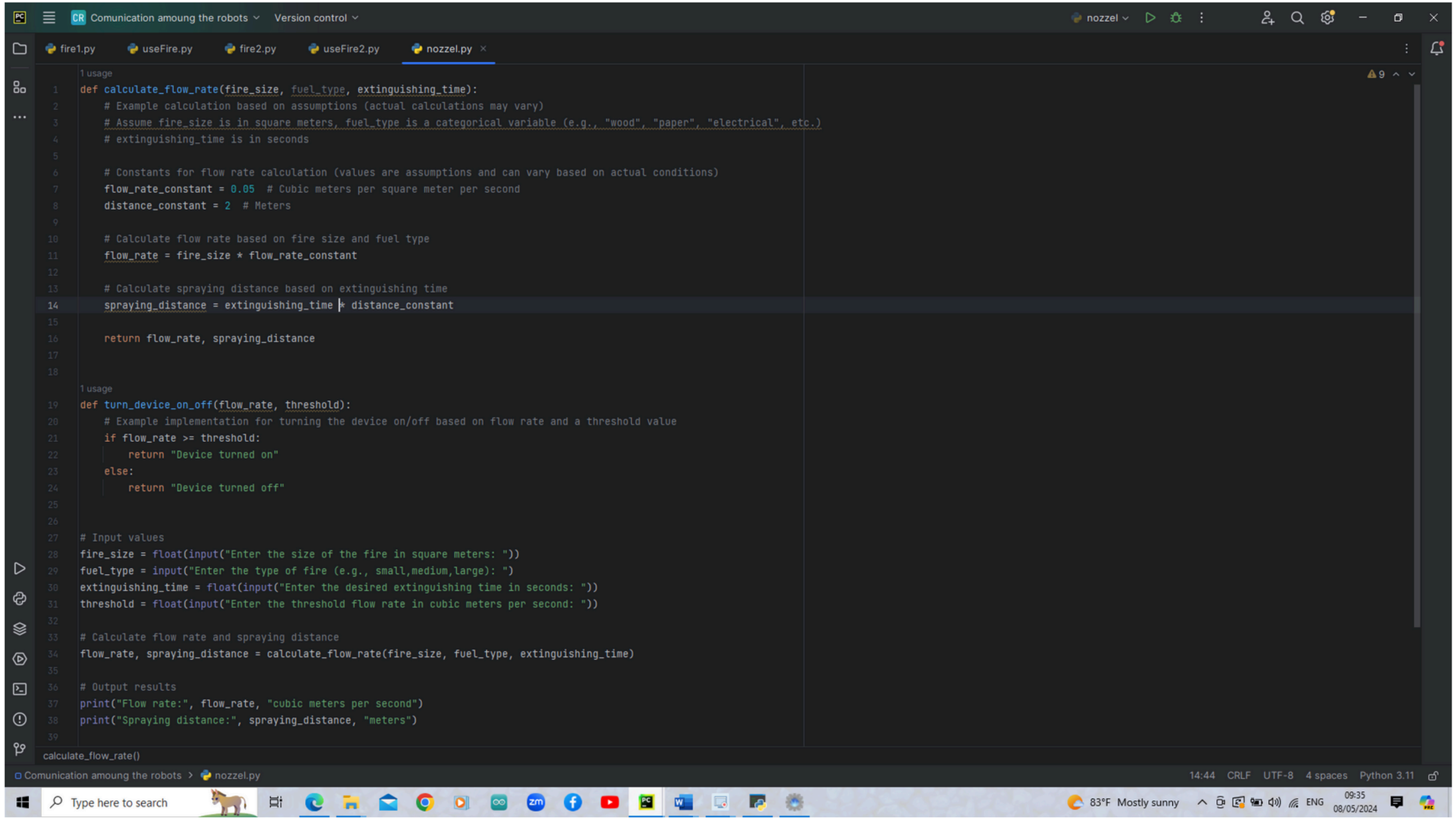


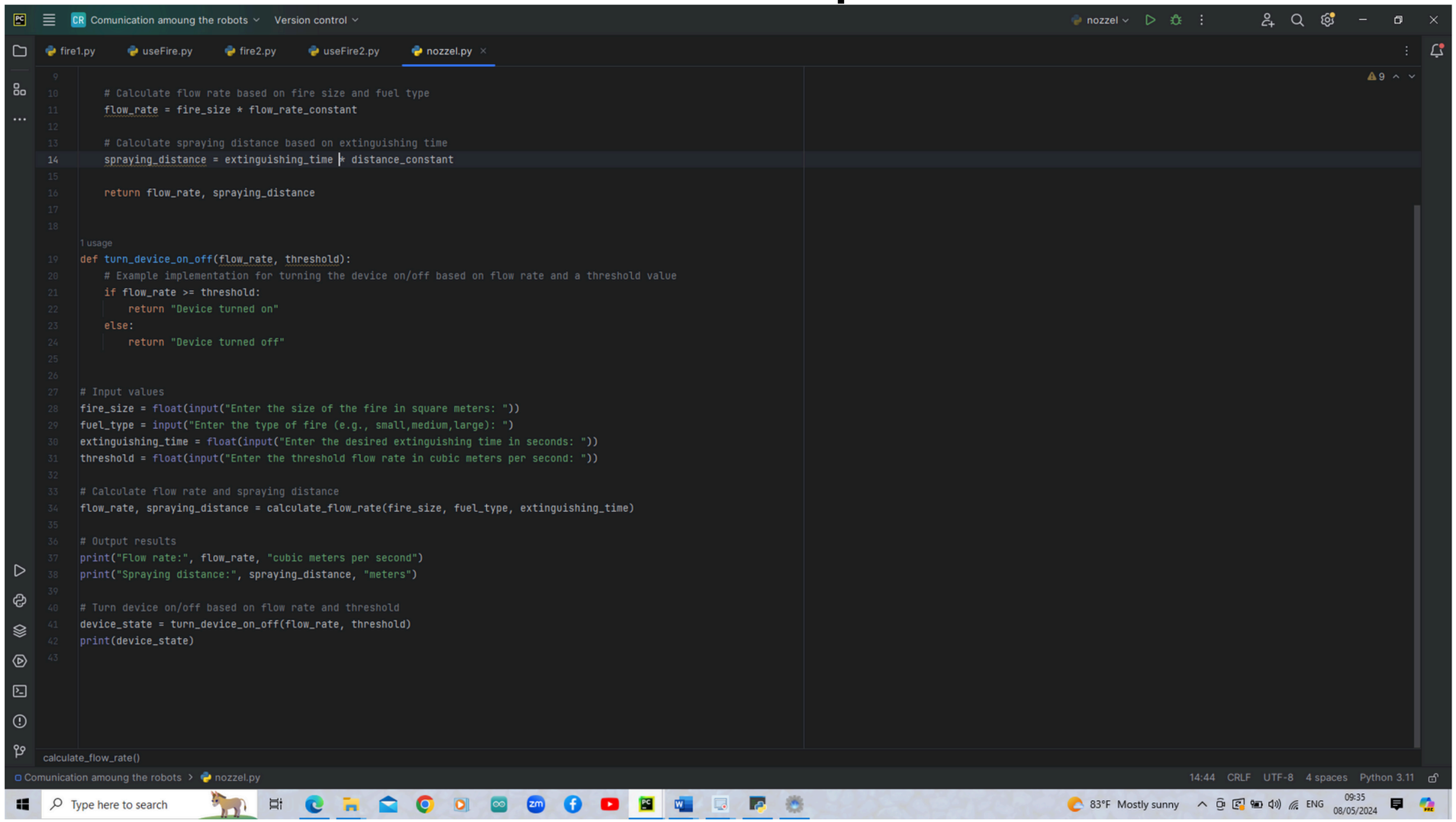
The output of the part that encodes the signal coming through the fire tracking system



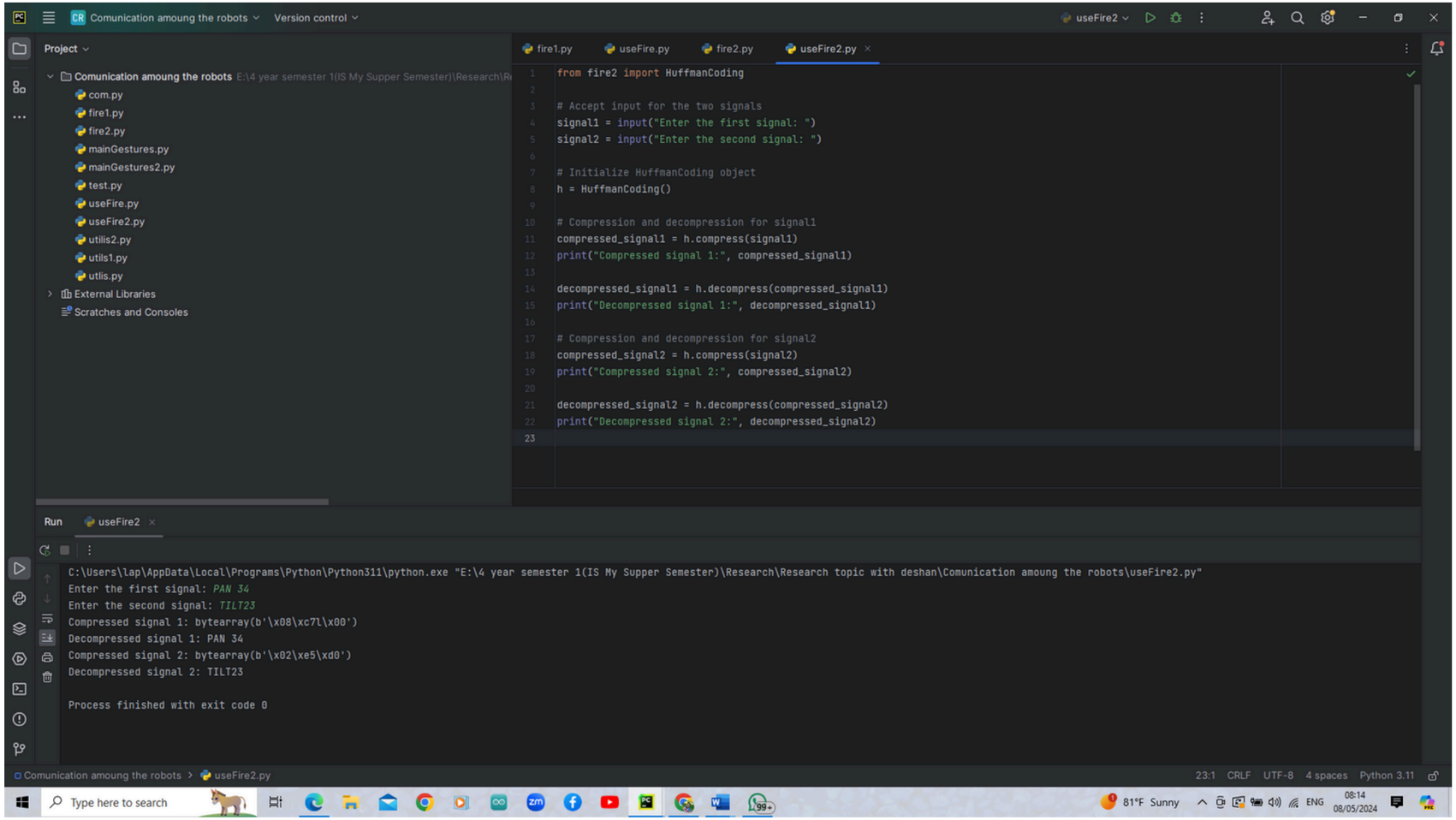
Nozzle on off Part



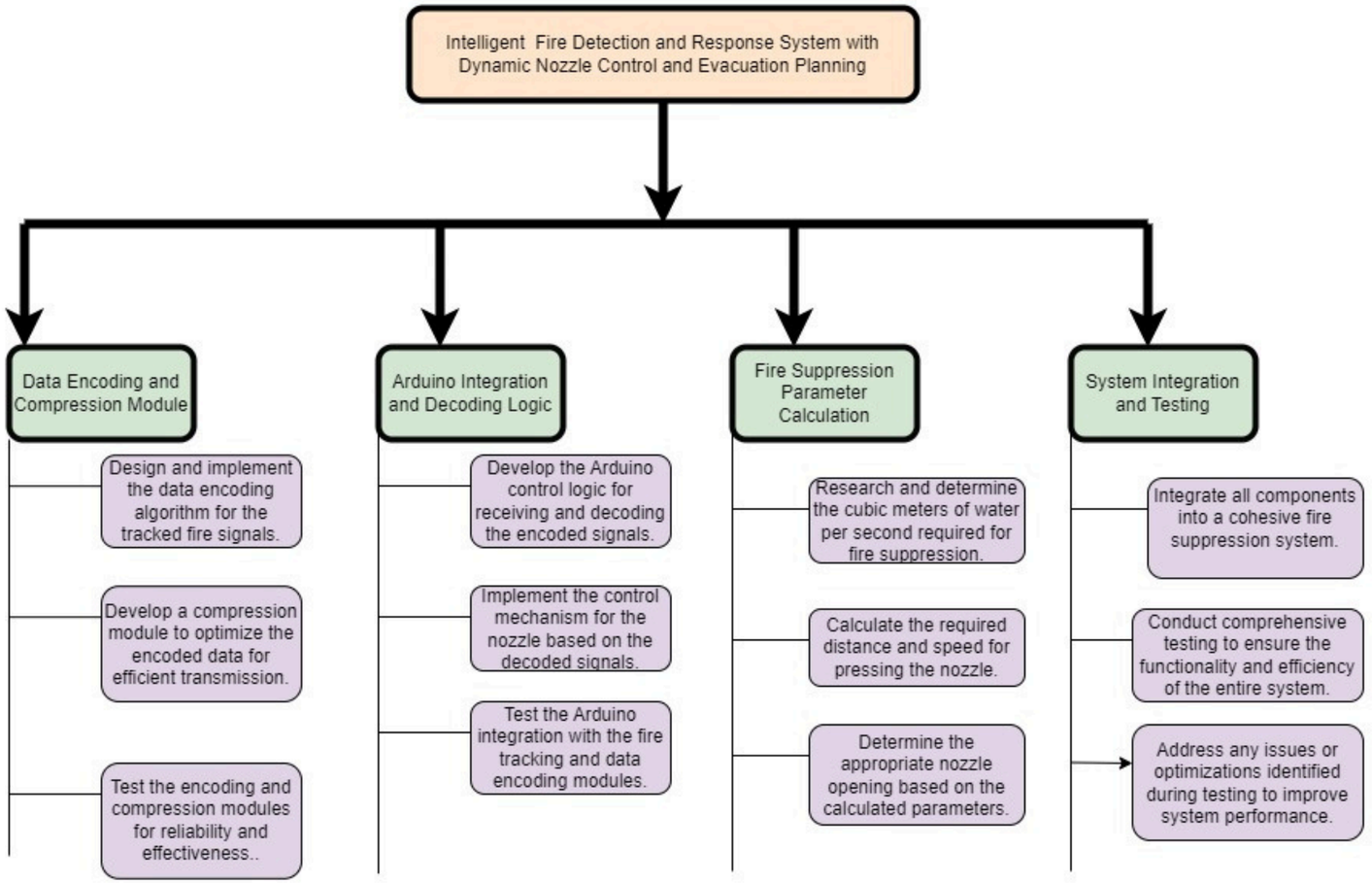
Nozzle on off part



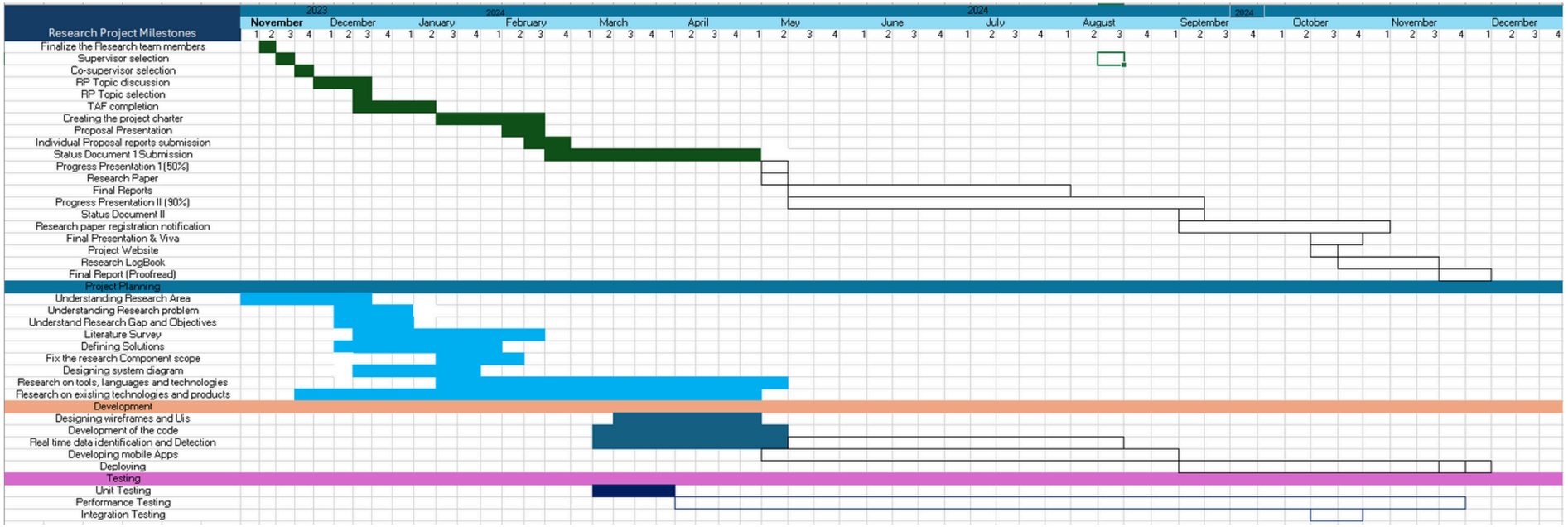
Nozzle on off part



Work Break Down Structure



Grant Chart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Research Project Milestones
Finalize the Research team members
Supervisor selection
Co-supervisor selection
RP Topic discussion
RP Topic selection
TAF completion
Creating the project charter
Proposal Presentation
Individual Proposal reports submission
Status Document 1 Submission
Progress Presentation 1 (50%)
Research Paper
Final Reports
Progress Presentation II (90%)
Status Document II
Research paper registration notification
Final Presentation & Viva
Project Website
Research LogBook
Final Report (Proofread)
Project Planning
Understanding Research Area
Understanding Research problem
Understand Research Gap and Objectives
Literature Survey
Defining Solutions
Fix the research Component scope
Designing system diagram
Research on tools, languages and technologies
Research on existing technologies and products
Development
Designing wireframes and UIs
Development of the code
Real time data identification and Detection
Developing mobile Apps
Deploying
Testing
Unit Testing
Performance Testing
Integration Testing

Project Completion

Completed Tasks

- ✓ Implemented the fire tracking system to track the fire.
- ✓ Developed the data encoding and compression module to encode the incoming signal.
- ✓ Integrated the Arduino decoding and control logic to decode the received signal and control the nozzle.
- ✓ Determine the cubic meters of water per second required to extinguish the fire

Tasks to be completed

- Calculate the required distance and speed to press the nozzle
- Determine the nozzle opening based on the calculated parameters.
- Test the entire system for functionality and efficiency.

References

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- JORGE PEÑA QUERALTA 1, (. S. (2020). Collaborative Multi-Robot Search and Rescue: Planning, Coordination, Perception, and Active Vision. 27. Retrieved from https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9220149

Manorathna A.Y.S

IT21086670

Specialization : Information Technology

Fire Tracking System

BACKGROUND

The background involves the development of a fire tracking system that utilizes a camera to detect and track fires. The system's main objective is to transmit tracking data, including pan and tilt information, to the communication part of the overall system.

Additionally, insights into the performance of the fire detection process, such as the time taken for different stages and the average processing speed per image, are provided.

As a future enhancement, expanding the system's capabilities to calculate the area covered by the fire and the time taken for its spread is planned. This background emphasizes the importance of real-time fire monitoring and data transmission for effective fire management and mitigation.

RESEARCH QUESTION

How can a fire tracking system utilizing camera technology effectively track, and transmit real-time data about fires, including pan and tilt information, and provide insights into the performance of the fire detection process for efficient fire management and mitigation?

RESEARCH GAP

The research gap for your part could be the lack of a comprehensive fire tracking system that integrates camera technology to detect, track, and transmit real-time data about fires, including pan and tilt information, while also providing insights into the performance of the fire detection process. Additionally, there may be a gap in the existing systems in terms of their ability to calculate the area covered by the fire and the time taken for its spread, highlighting the need for further development in this area.

SPECIFIC AND SUB OBJECTIVES

Specific Objective

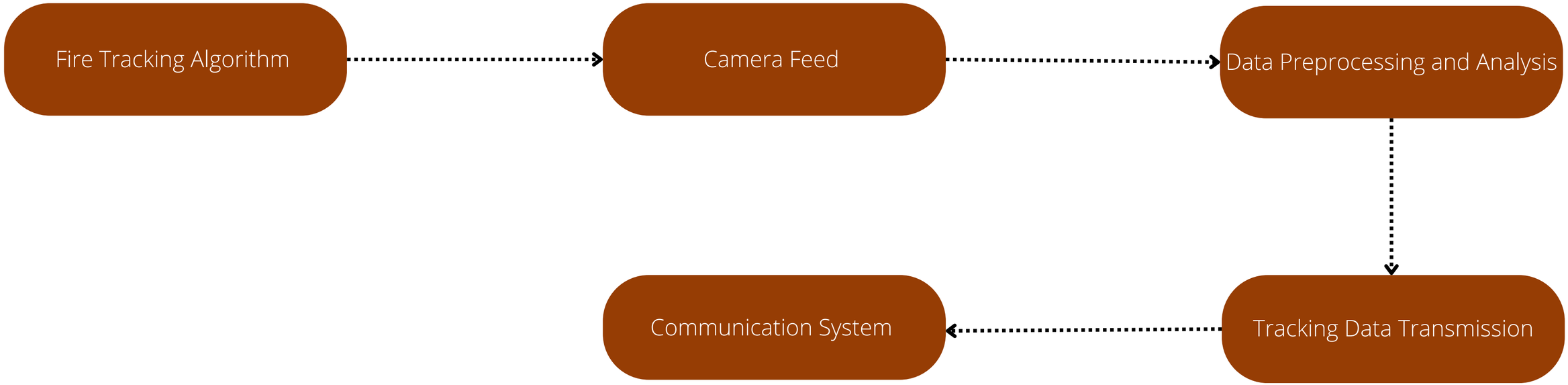
To develop a fire tracking system that utilizes a camera to track fires, and to transmit the tracking data to the communication part of the system.

SPECIFIC AND SUB OBJECTIVES

Sub objectives

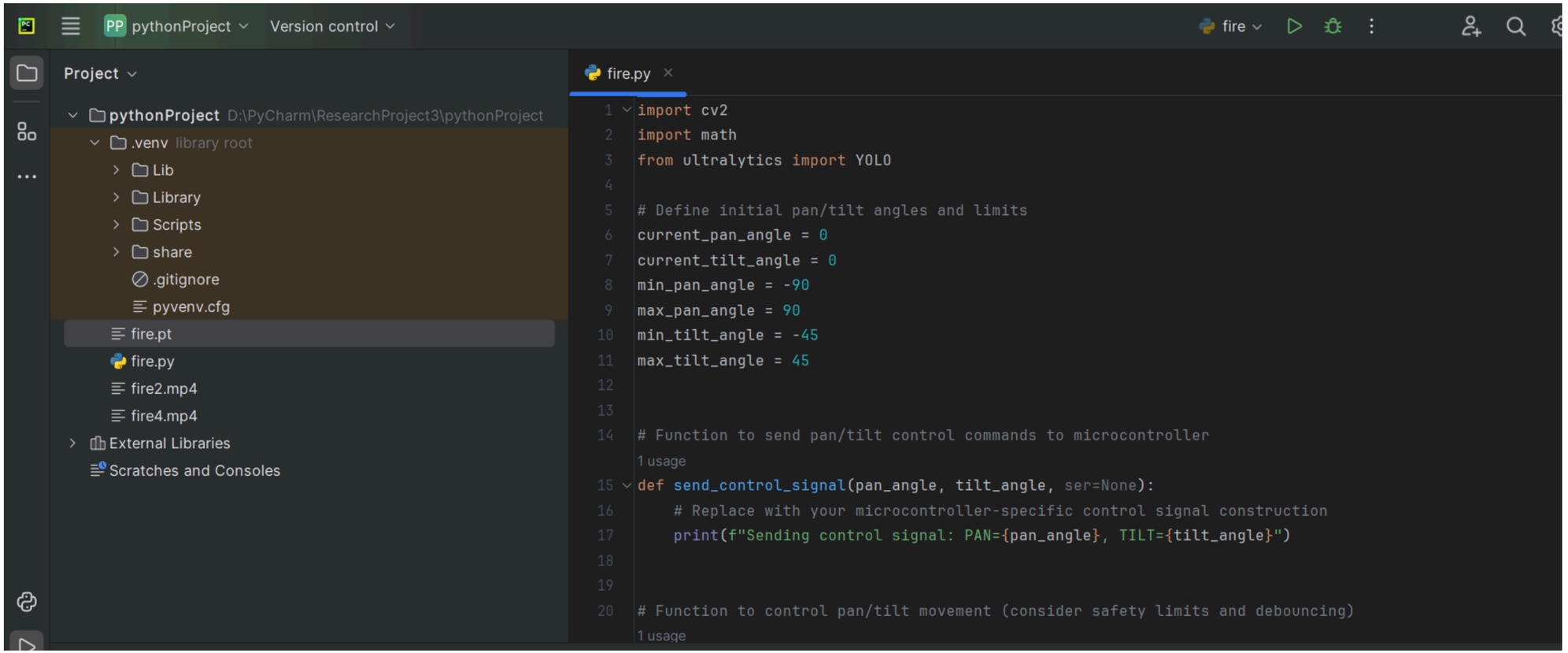
- Develop algorithms for fire detection and continuous tracking using camera feed.
- Gather tracking data and analyze system performance metrics.
- Evaluate system accuracy and efficiency under varied conditions and optimize as needed.
- Develop algorithms to measure fire spread area and rate over time, analyzing influencing factors.

SYSTEM DIAGRAM



Project Evidence

Initiation setup and functions definitions for camera Control



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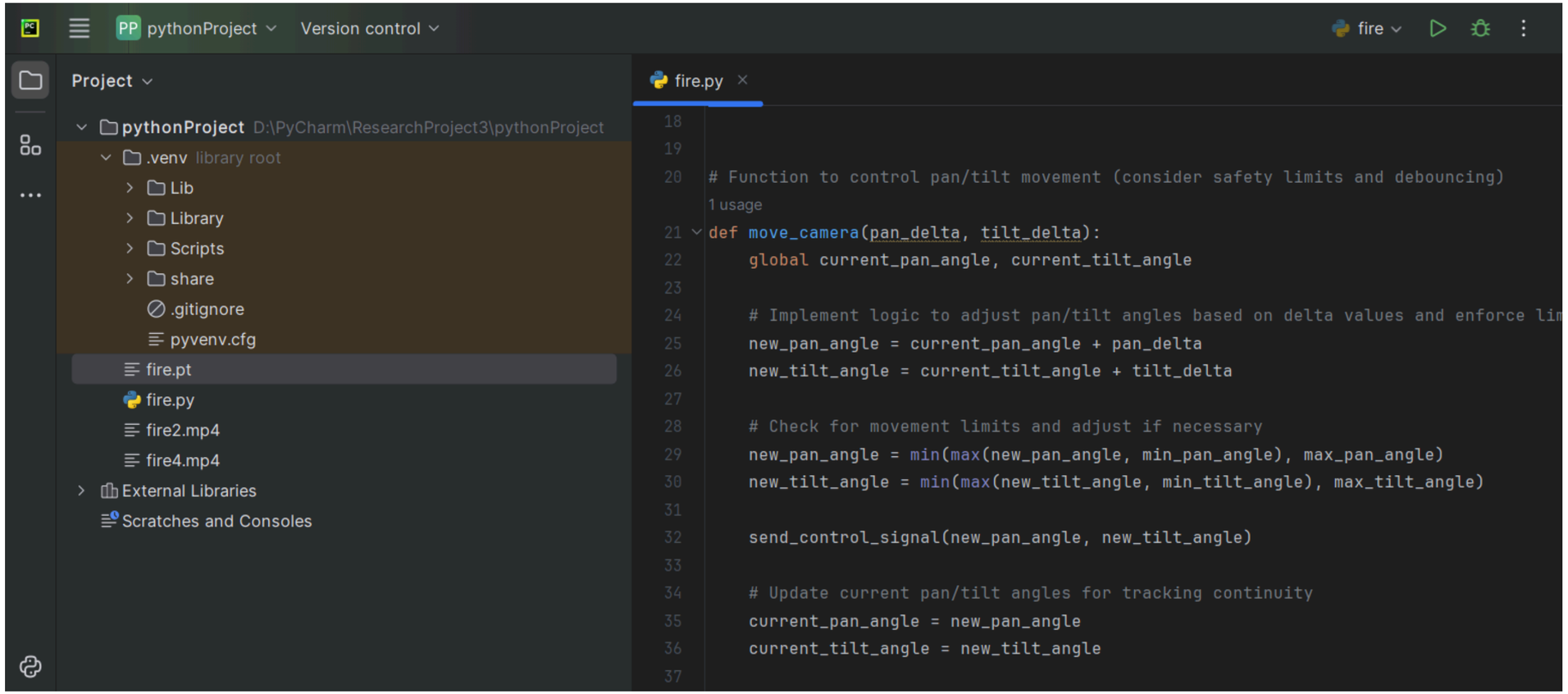
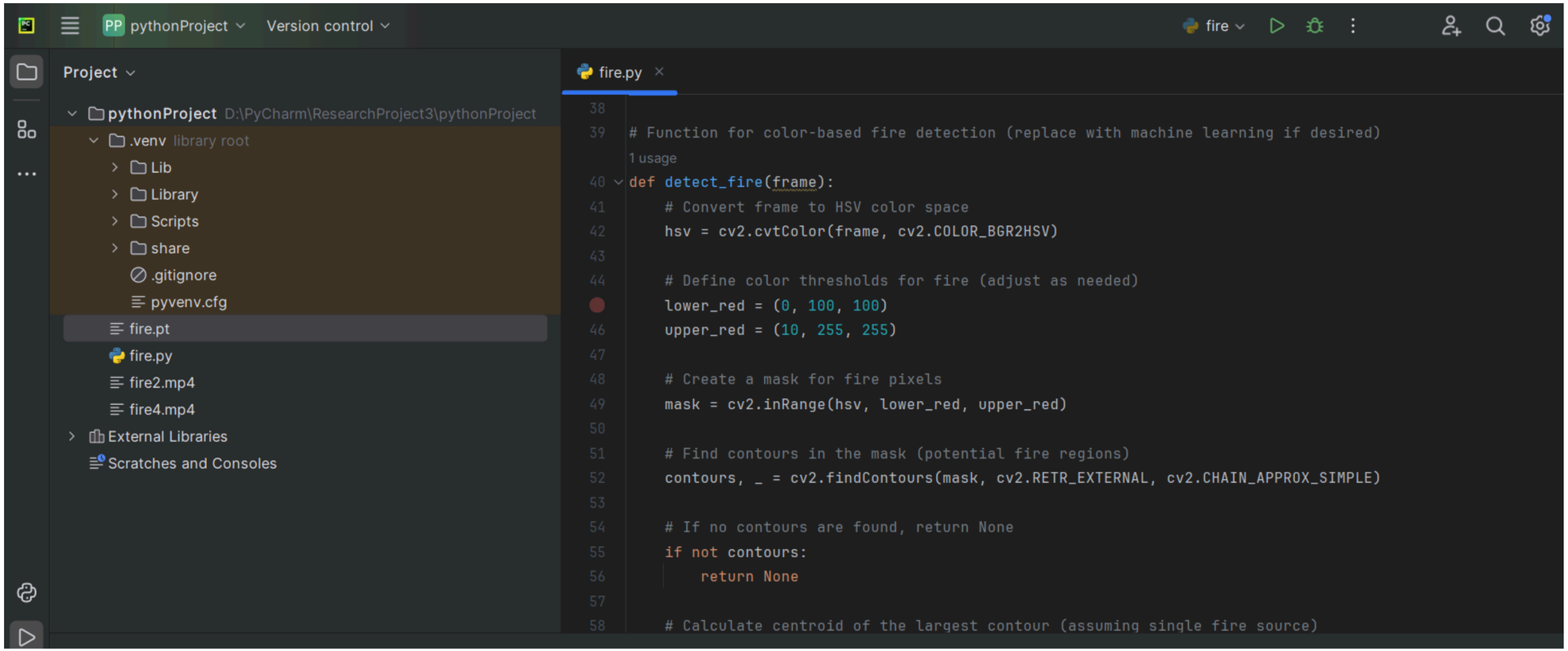
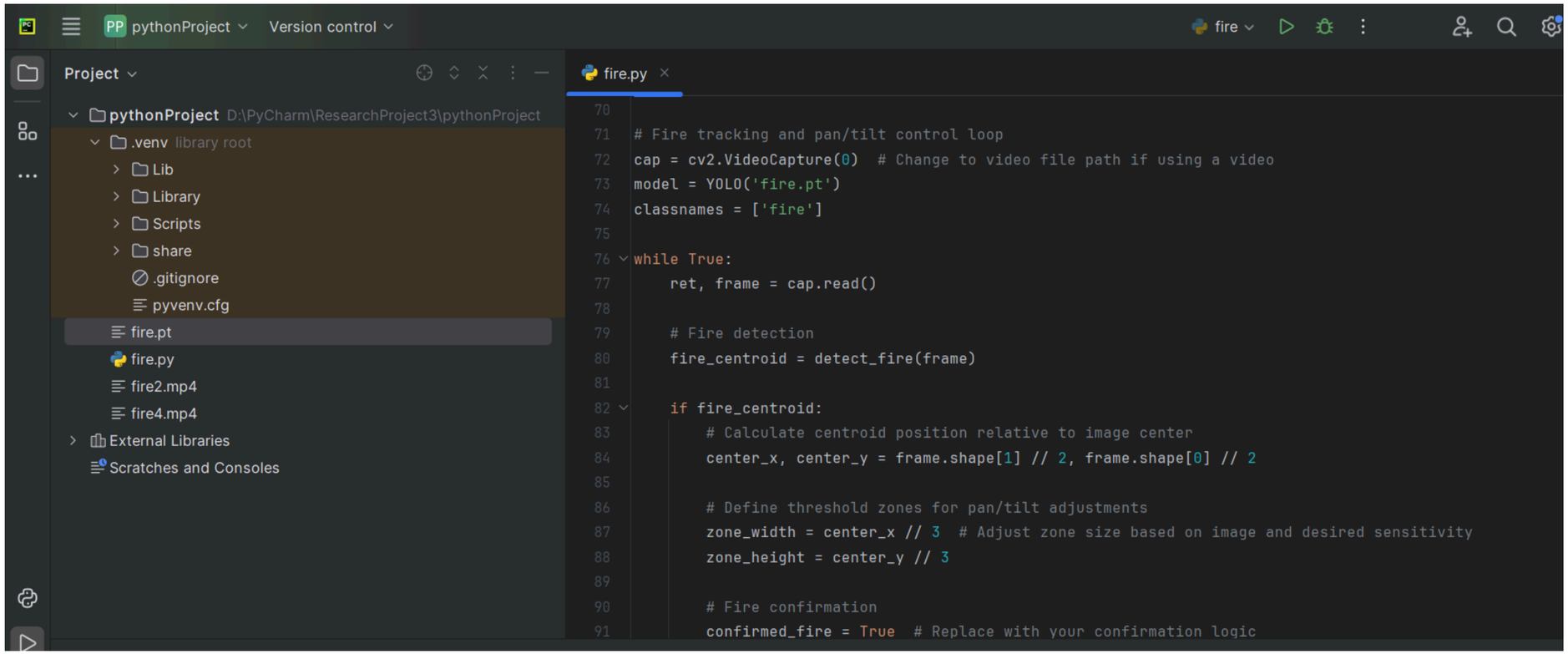


Project Evidence
Fire Detection Function

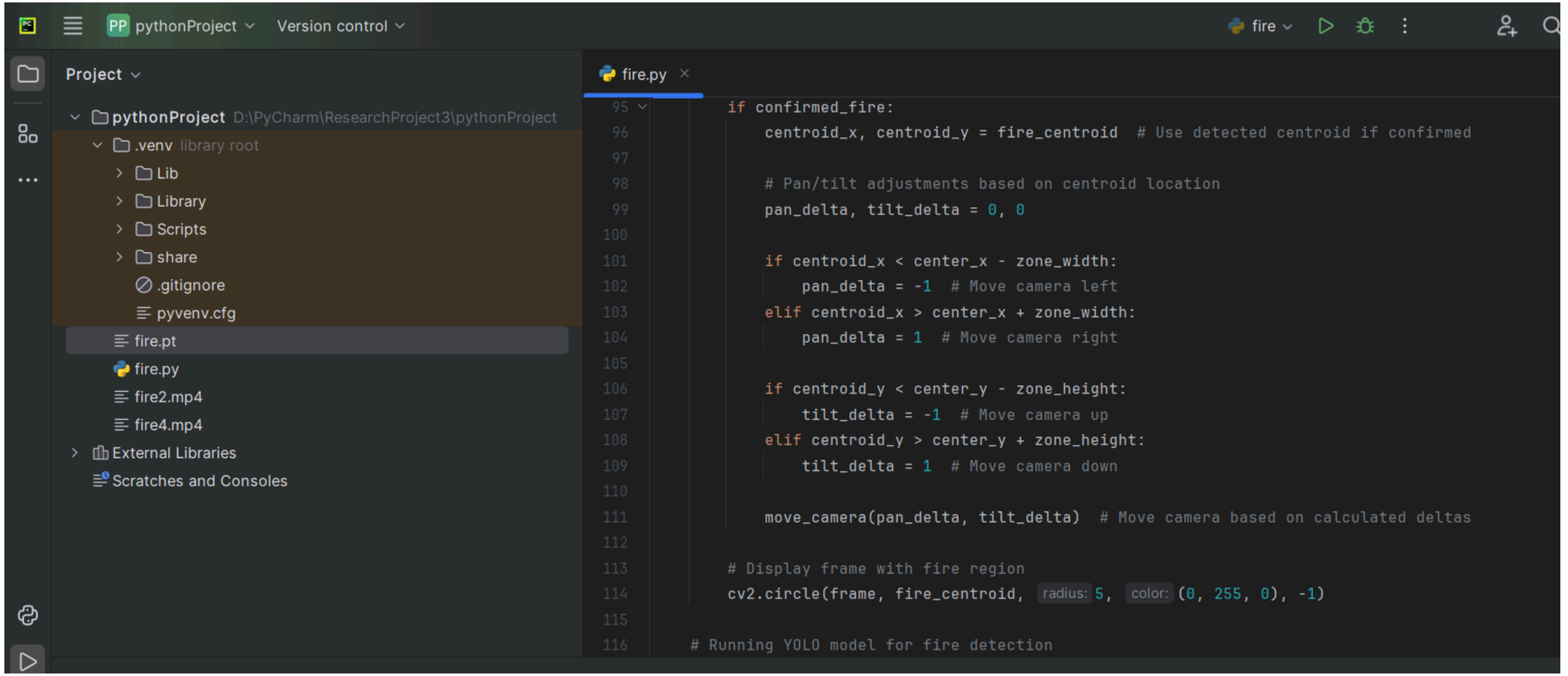


Project Evidence
Main Loop for Fire Tracking and Fire Detection Model (YOLO) Integration



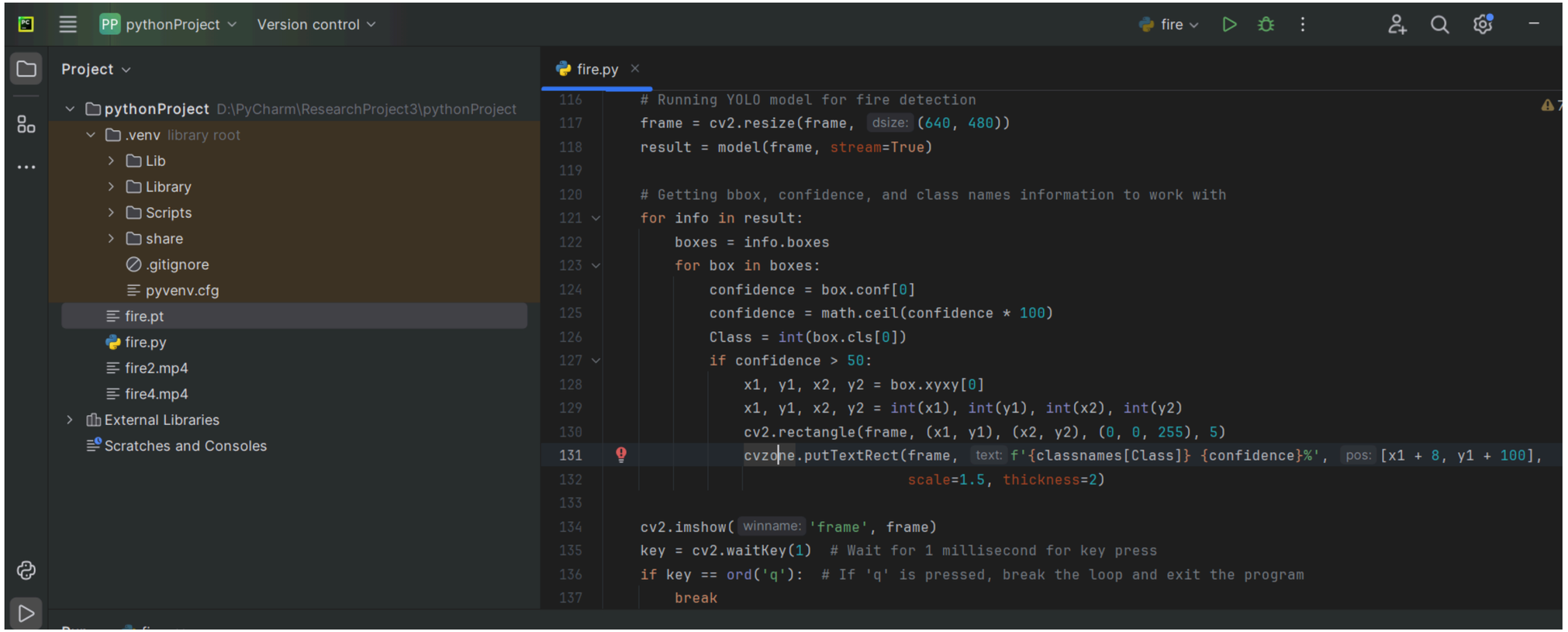
Project Evidence

Main Loop for Fire Tracking and Fire Detection Model (YOLO)

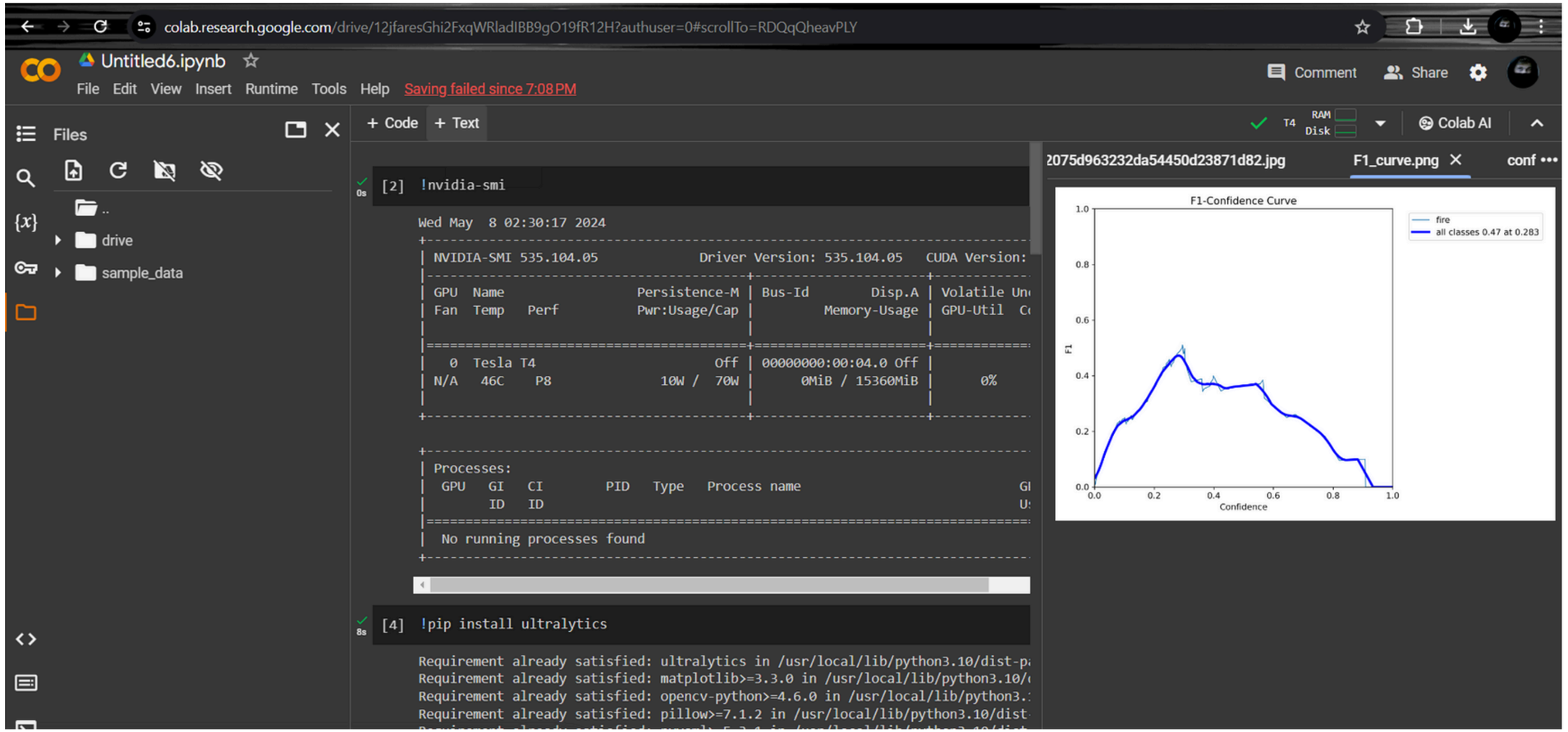


Project Evidence

Main Loop for Fire Tracking and Fire Detection Model (YOLO)



Project Evidence
Model Development



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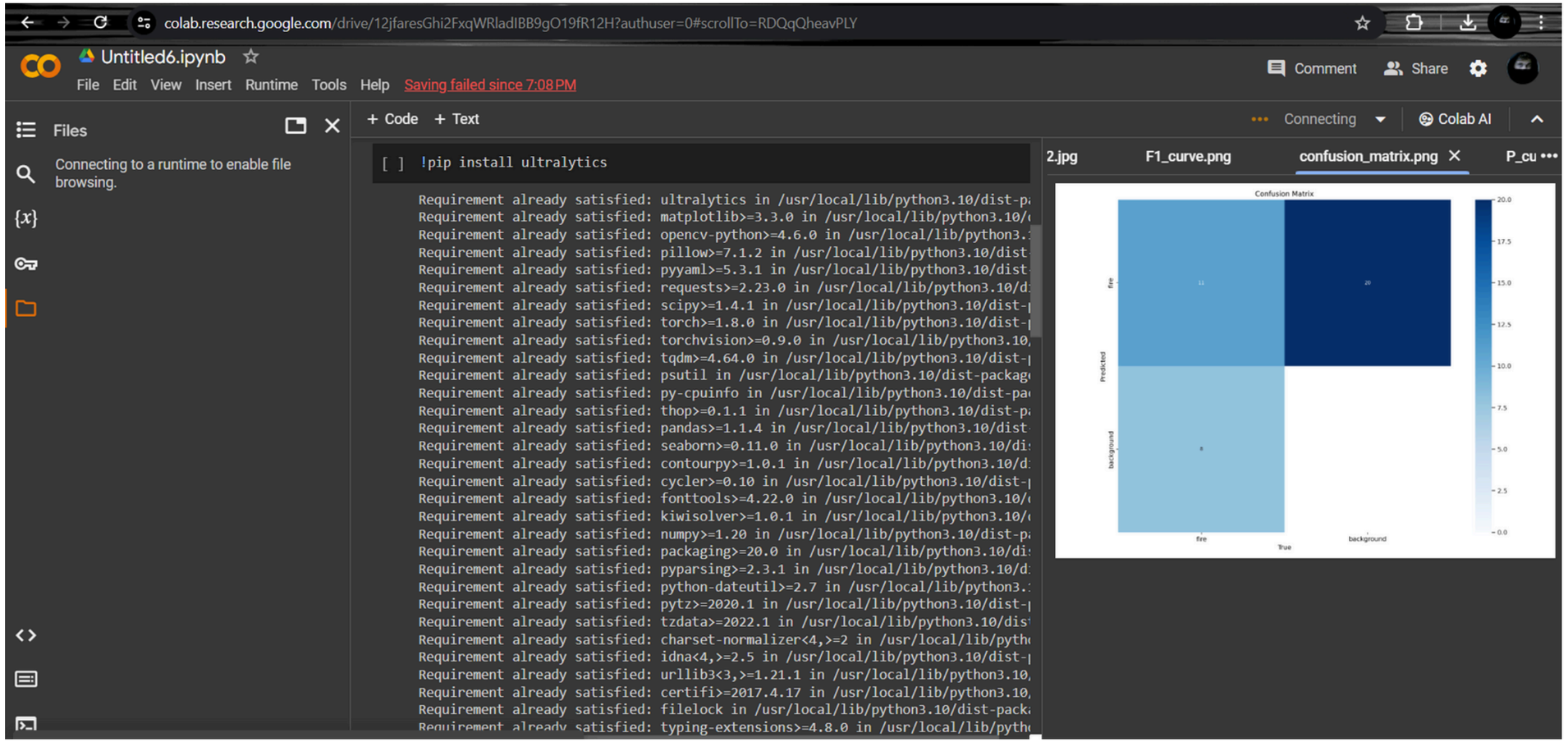

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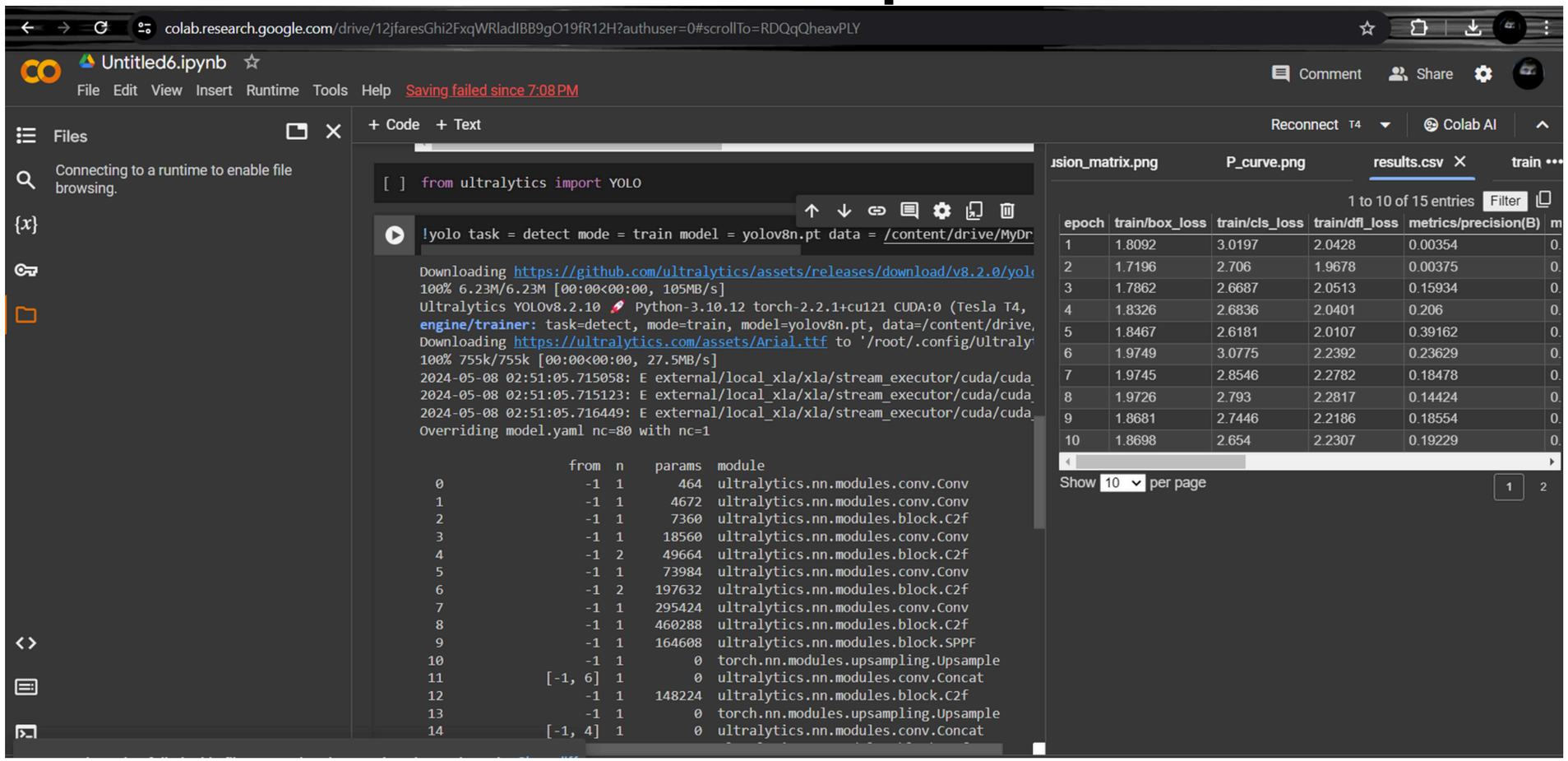

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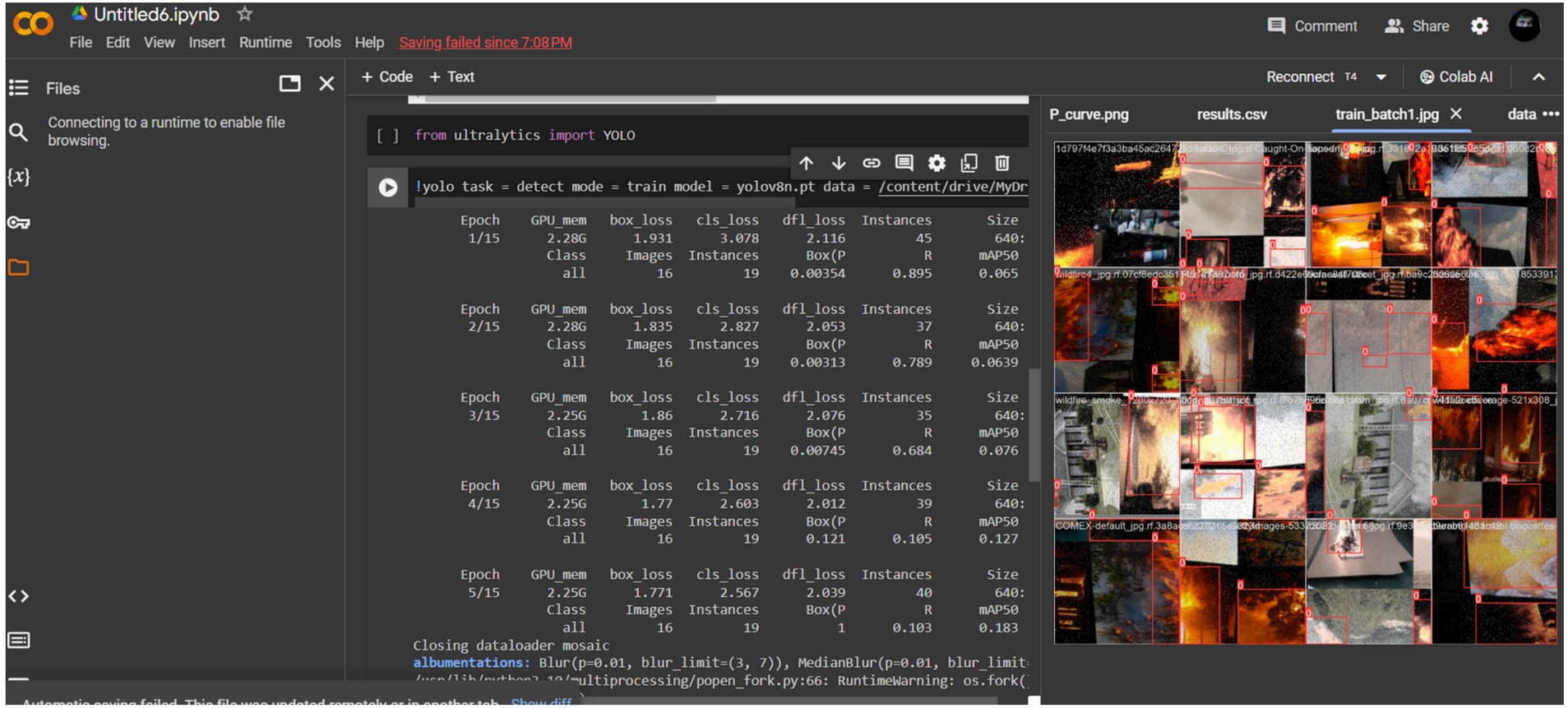

Project Evidence
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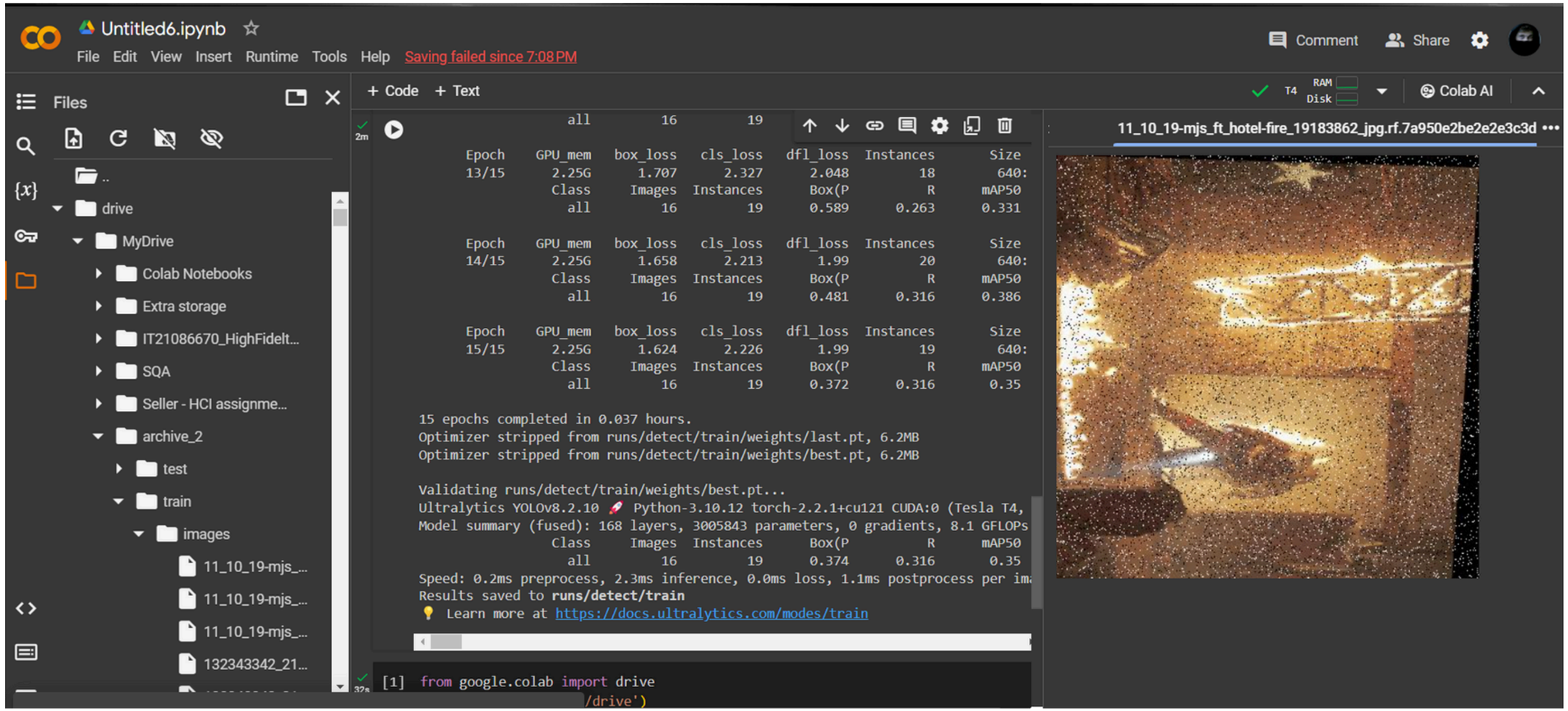
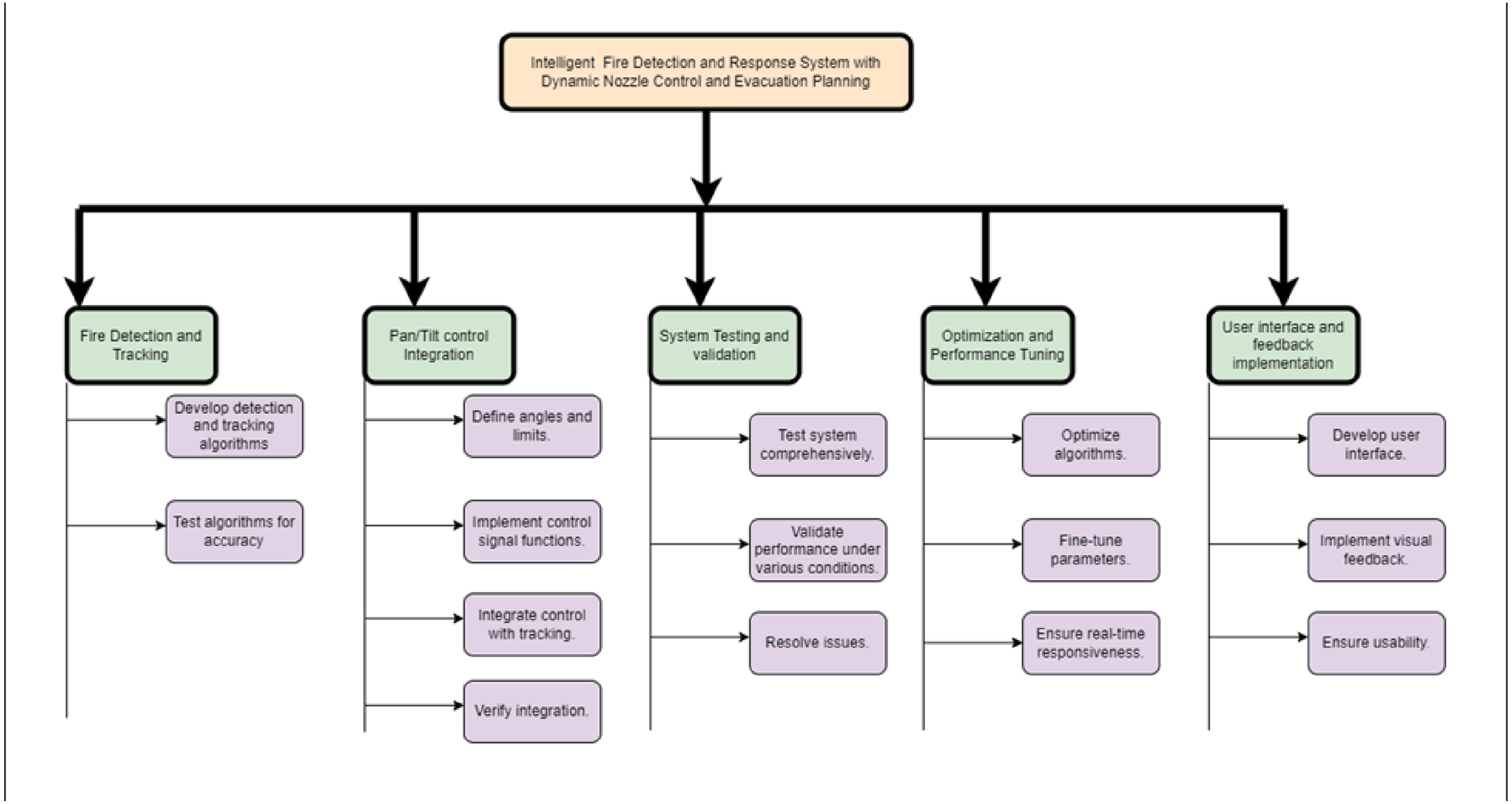
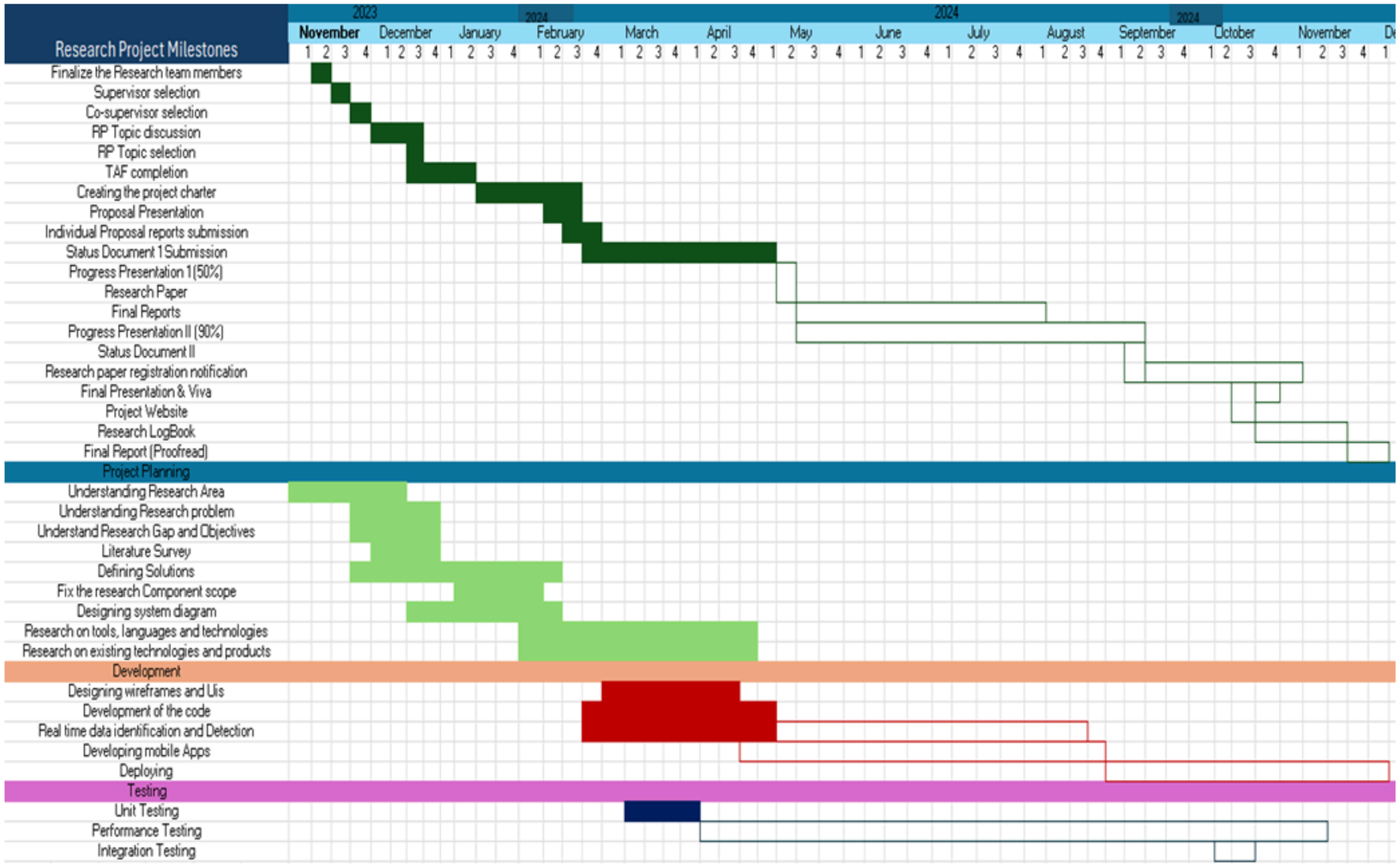


Work Break Down Structure



Grant Chart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Research Project Milestones
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Individual Proposal reports submission
Status Document 1 Submission
Progress Presentation 1 (50%)
Research Paper
Final Reports
Progress Presentation II (90%)
Status Document II
Research paper registration notification
Final Presentation & Viva
Project Website
Research LogBook
Final Report (Proofread)
Project Planning
Understanding Research Area
Understanding Research problem
Understand Research Gap and Objectives
Literature Survey
Defining Solutions
Fix the research Component scope
Designing system diagram
Research on tools, languages and technologies
Research on existing technologies and products
Development
Designing wireframes and UIs
Development of the code
Real time data identification and Detection
Developing mobile Apps
Deploying
Testing
Unit Testing
Performance Testing
Integration Testing

Project Completion

Completed Tasks

- ✓ Developed a fire tracking system utilizing a camera to track fires.
- ✓ Implemented the transmission of tracking data to the communication part of the system.
- ✓ Provided insights into the performance of the fire detection process, including time taken for different stages and average processing speed per image.
- ✓ Implemented initial pan/tilt definitions, control signal functions, and integrated fire tracking for continuous camera position adjustment.

Tasks to be completed

- Enhance the system to calculate the area covered by fire.
- Enhance the system to calculate the time taken for the fire to spread.

References

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THARUSHIKA W.A.V

IT21100116

Specialization : Information Technology

Identification of the Fire disaster

BACKGROUND

1. **Fire Flame Detection:** Need for advanced flame detection;Traditional methods struggle amidst varied conditions; accurate differentiation essential..
2. **Enhancing flame detection accuracy through computer vision:** Shape and motion analysis extract vital visual features for precise identification.
3. **Critical need for robust flame detection algorithms:** Must perform effectively in diverse, challenging environments to enhance emergency response.
4. **Novel approach:** Fuse shape and motion analysis with traditional methods for enhanced flame detection accuracy, overcoming existing limitations.

RESEARCH QUESTION

How can the integration of shape analysis and motion analysis techniques enhance the accuracy and robustness of fire flame detection in real-time camera feeds during emergency situations?

RESEARCH GAP

Existing flame detection methods often lack robustness in dynamic environments. There's a gap in implementing shape and motion analysis techniques for accurate flame identification in real-time camera feeds during emergency scenarios

SPECIFIC AND SUB OBJECTIVES

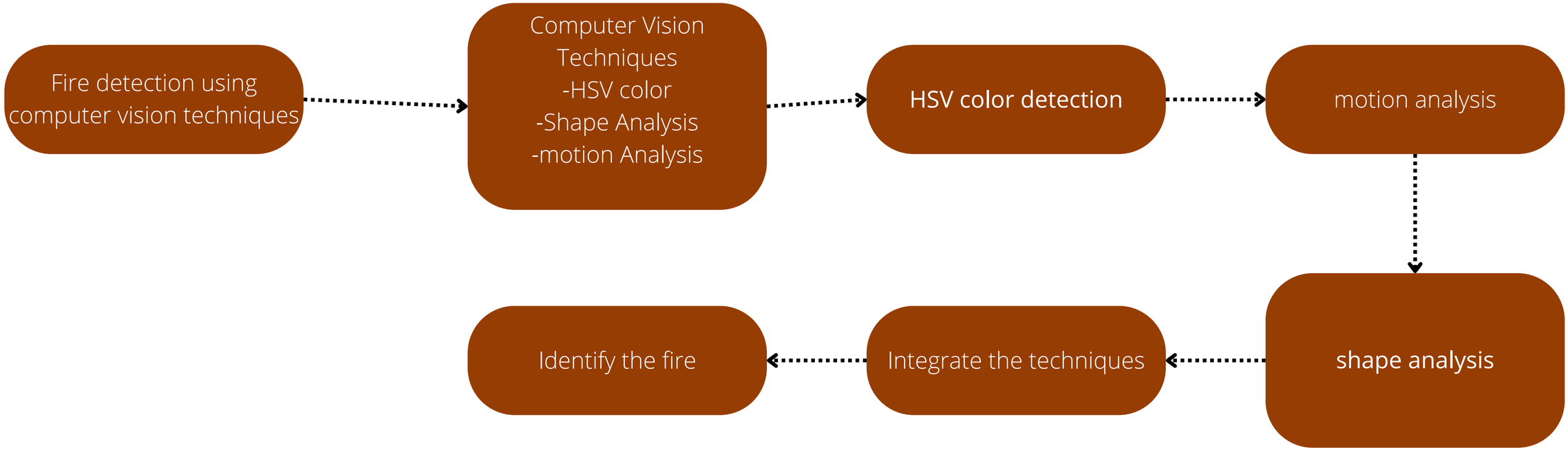
Develop Shape Analysis Techniques for Flame Detection

- Design algorithms to detect flame contours and extract relevant shape features.
- Implement methods to filter out non-flame regions based on shape characteristics.
- Validate the effectiveness of shape analysis techniques through quantitative evaluation metrics.
- Optimize shape analysis algorithms for real-time performance on camera feeds.

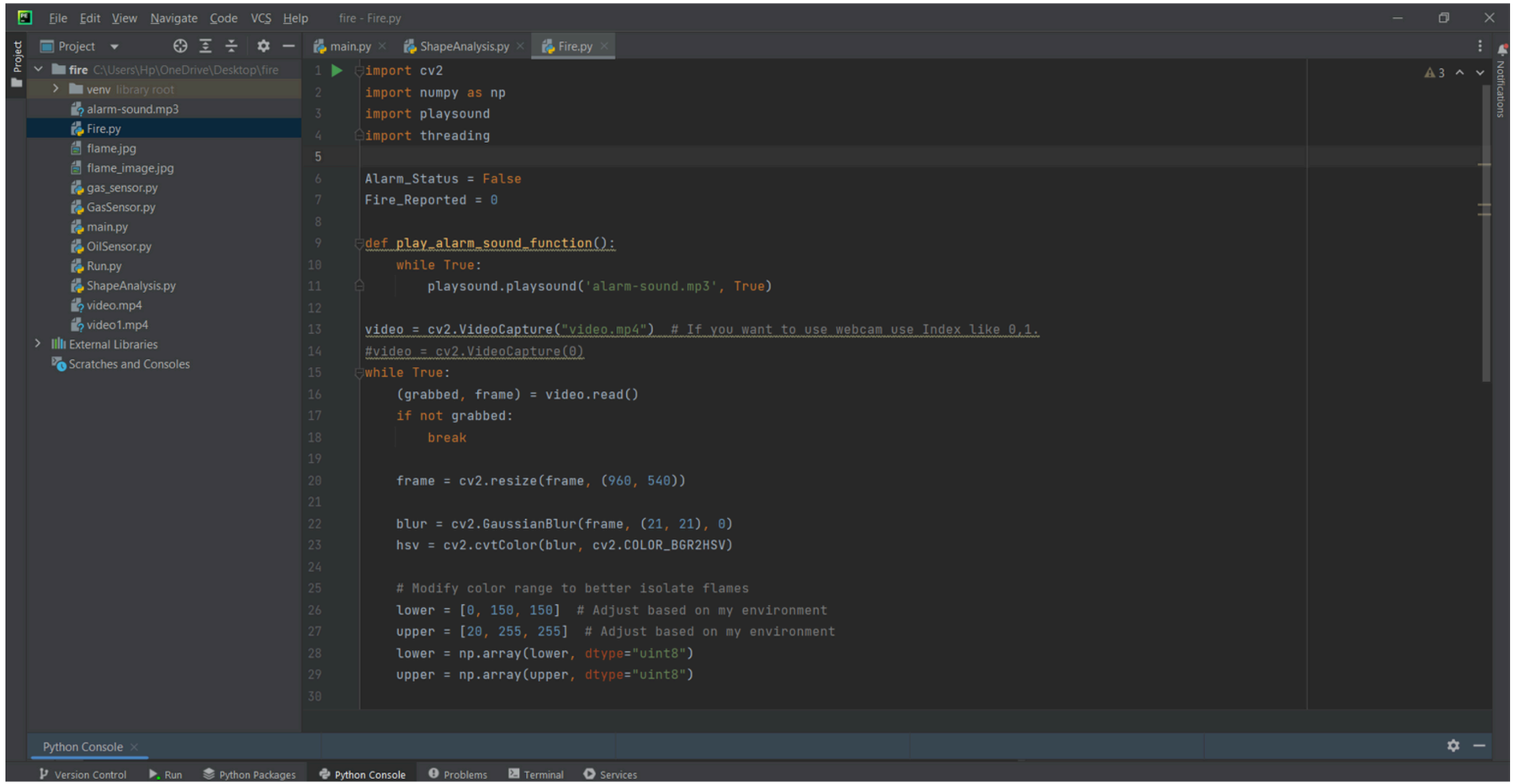
Implement Motion Analysis Techniques for Flame Detection

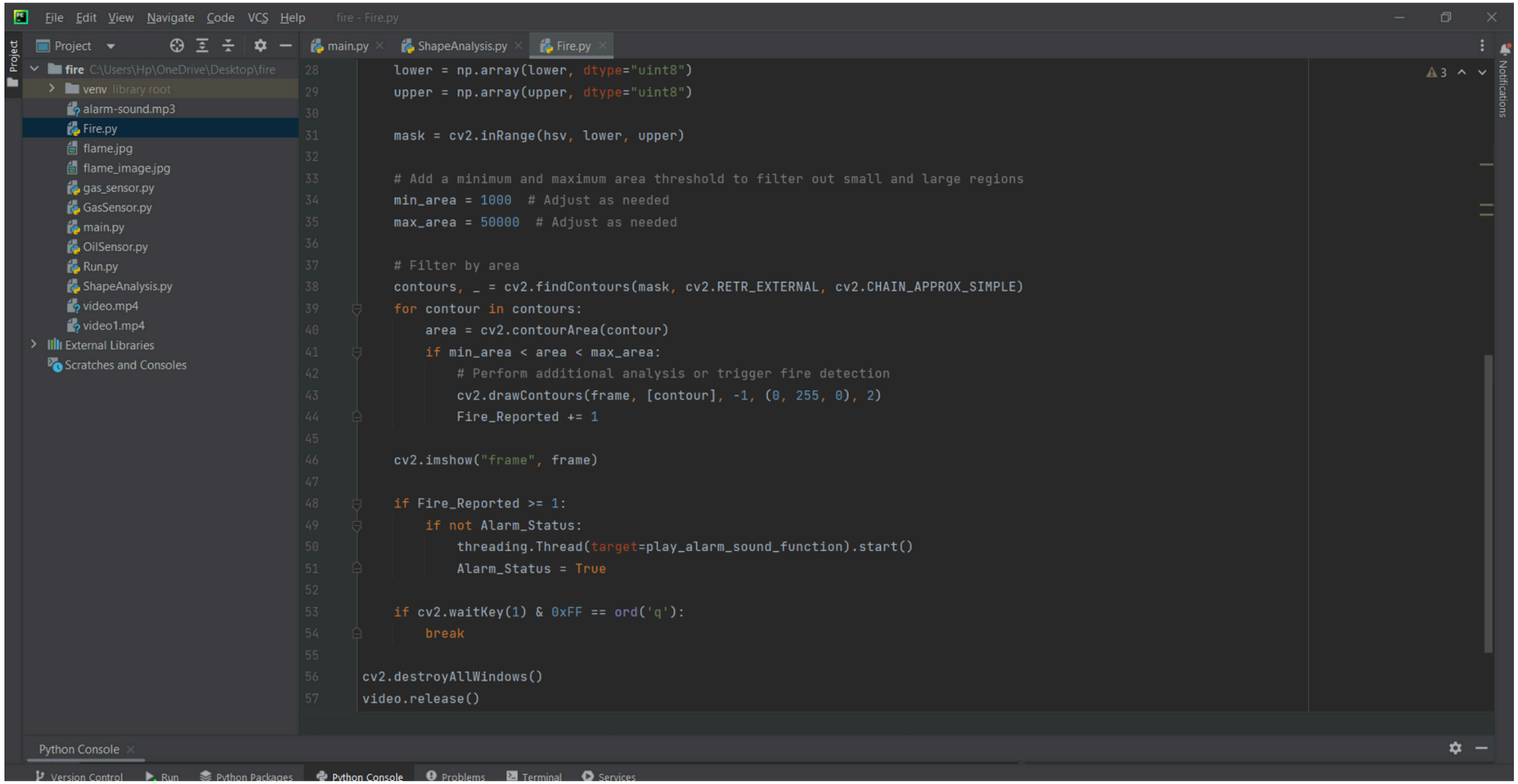
- Develop algorithms to detect flame-like motion patterns in video frames.
- Design mechanisms to differentiate flame motion from background movement.
- Assess the performance of motion analysis techniques under varying environmental conditions.
- Integrate motion analysis algorithms with real-time processing systems for camera feeds.

SYSTEM DIAGRAM



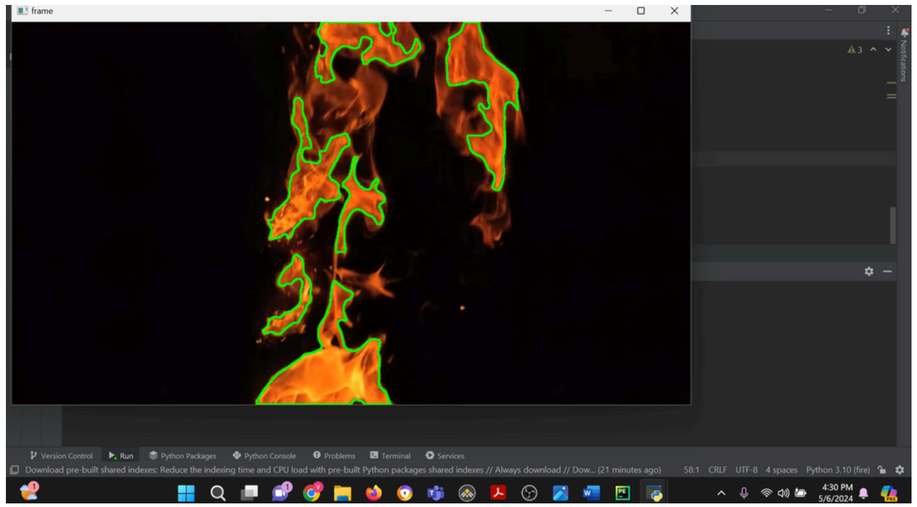
Project Evidence
flame detection using HSV colors

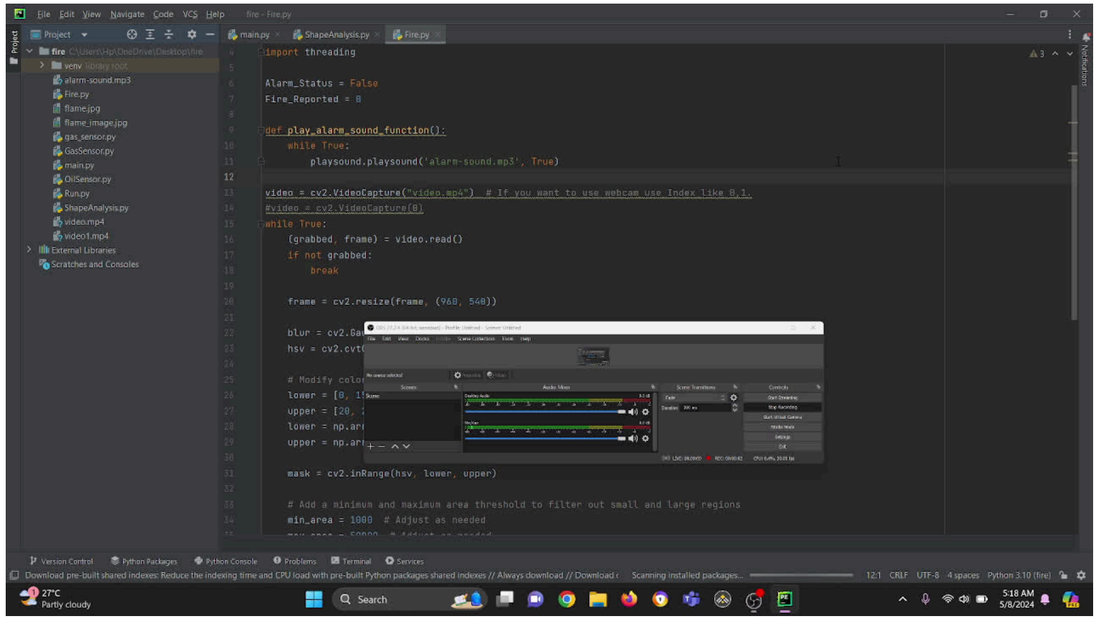



File Edit View Navigate Code VCS Help
fire - Fire.py
Project
main.py
ShapeAnalysis.py
Fire.py
fire C:\Users\Hp\OneDrive\Desktop\fire
venv library root
alarm-sound.mp3
Fire.py
flame.jpg
flame_image.jpg
gas_sensor.py
GasSensor.py
main.py
OilSensor.py
Run.py
ShapeAnalysis.py
video.mp4
video1.mp4
External Libraries
Scratches and Consoles
lower = np.array(lower, dtype="uint8")
upper = np.array(upper, dtype="uint8")
mask = cv2.inRange(hsv, lower, upper)
# Add a minimum and maximum area threshold to filter out small and large regions
min_area = 1000 # Adjust as needed
max_area = 50000 # Adjust as needed
# Filter by area
contours, _ = cv2.findContours(mask, cv2.RETR_EXTERNAL, cv2.CHAIN_APPROX_SIMPLE)
for contour in contours:
area = cv2.contourArea(contour)
if min_area < area < max_area:
# Perform additional analysis or trigger fire detection
cv2.drawContours(frame, [contour], -1, (0, 255, 0), 2)
Fire_Reported += 1
cv2.imshow("frame", frame)
if Fire_Reported >= 1:
if not Alarm_Status:
threading.Thread(target=play_alarm_sound_function).start()
Alarm_Status = True
if cv2.waitKey(1) & 0xFF == ord('q'):
break
cv2.destroyAllWindows()
video.release()
Python Console
Version Control
Run
Python Packages
Python Console
Problems
Terminal
Services
Notifications

Project Evidence

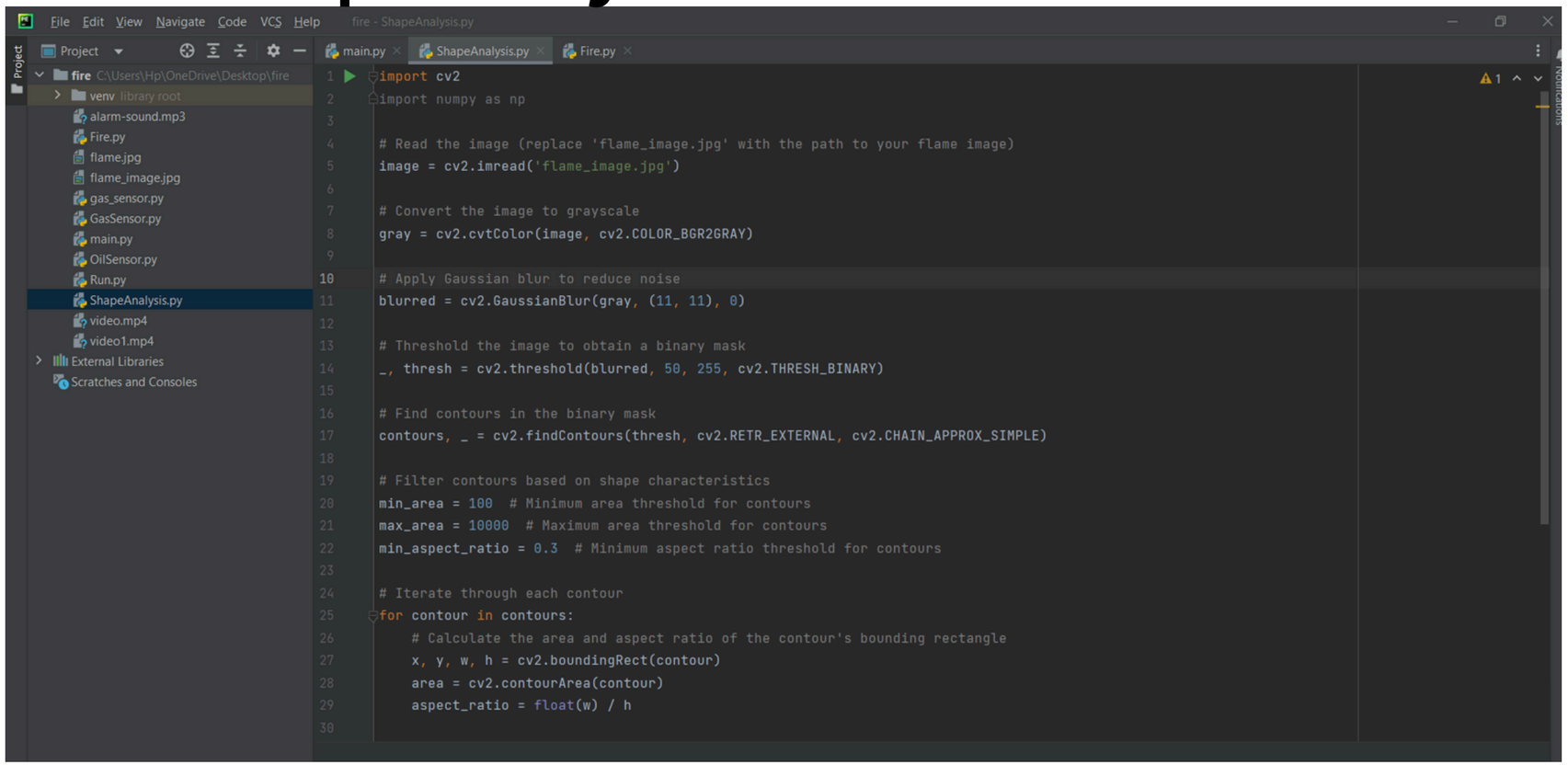
Output of the flame detection using HSV colors





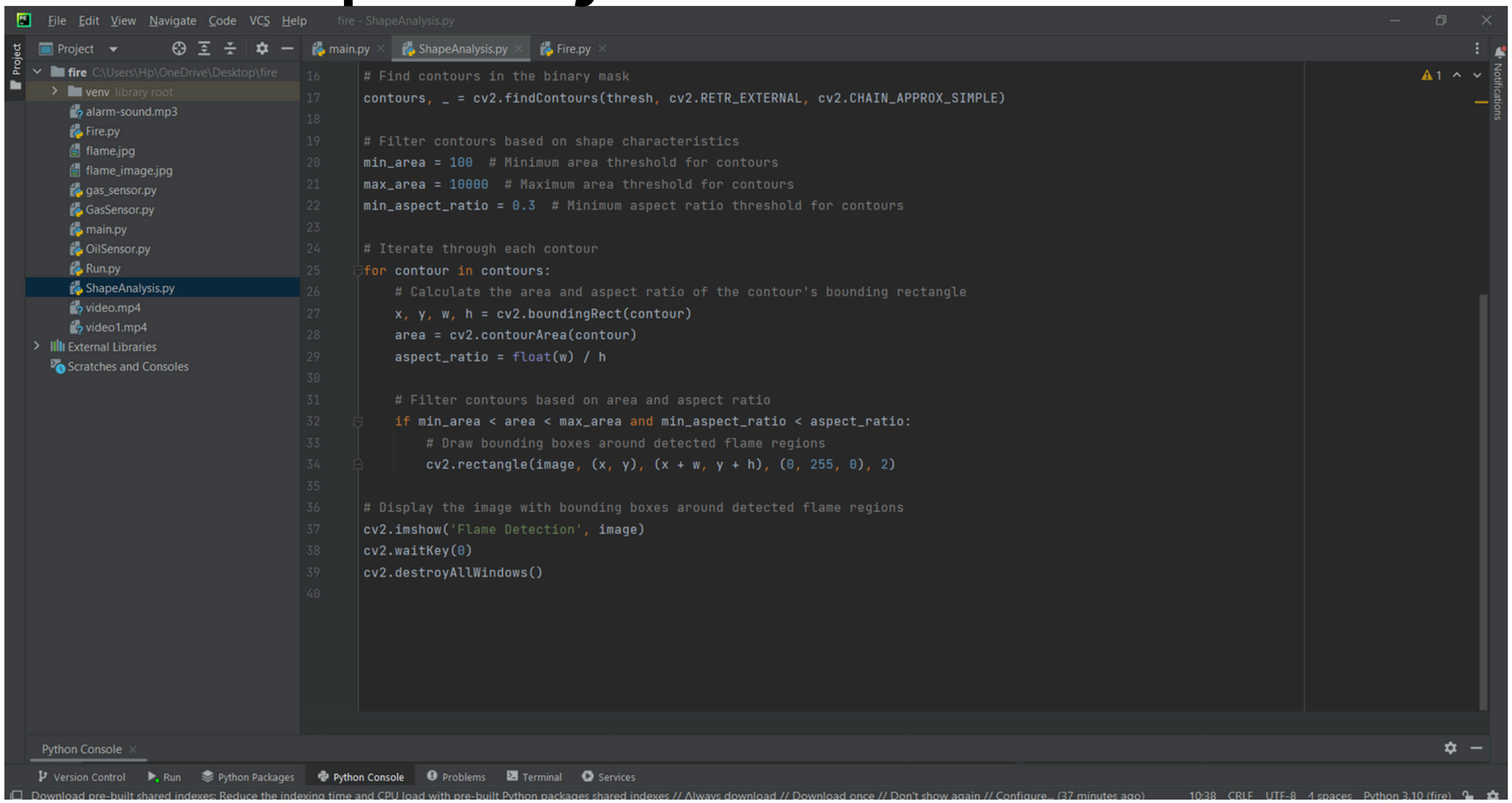
Project Evidence

Shape Analysis of the Fire flames



Project Evidence

Shape Analysis of the Fire flames

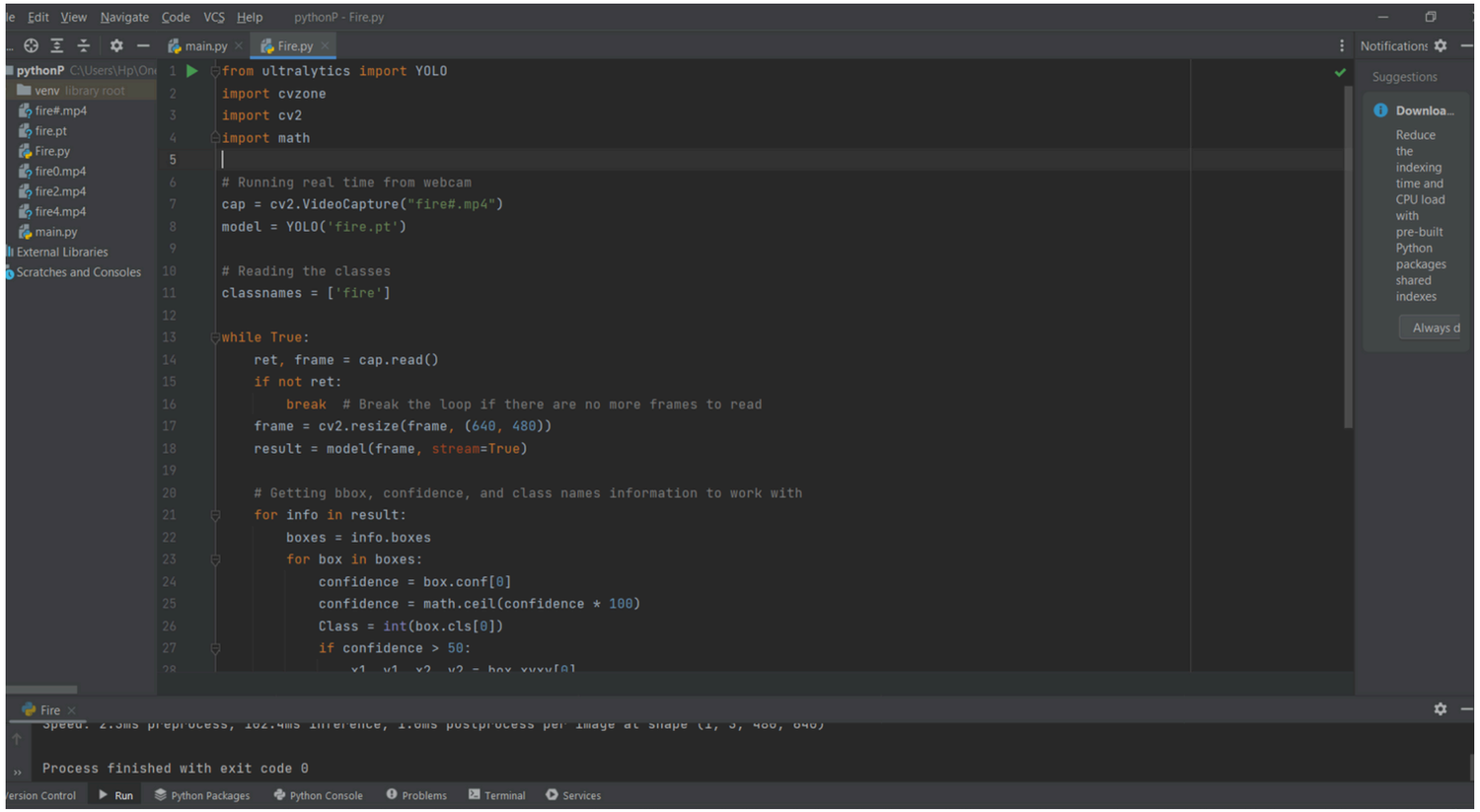


Project Evidence

Output of the flame detection using Shape Analysis

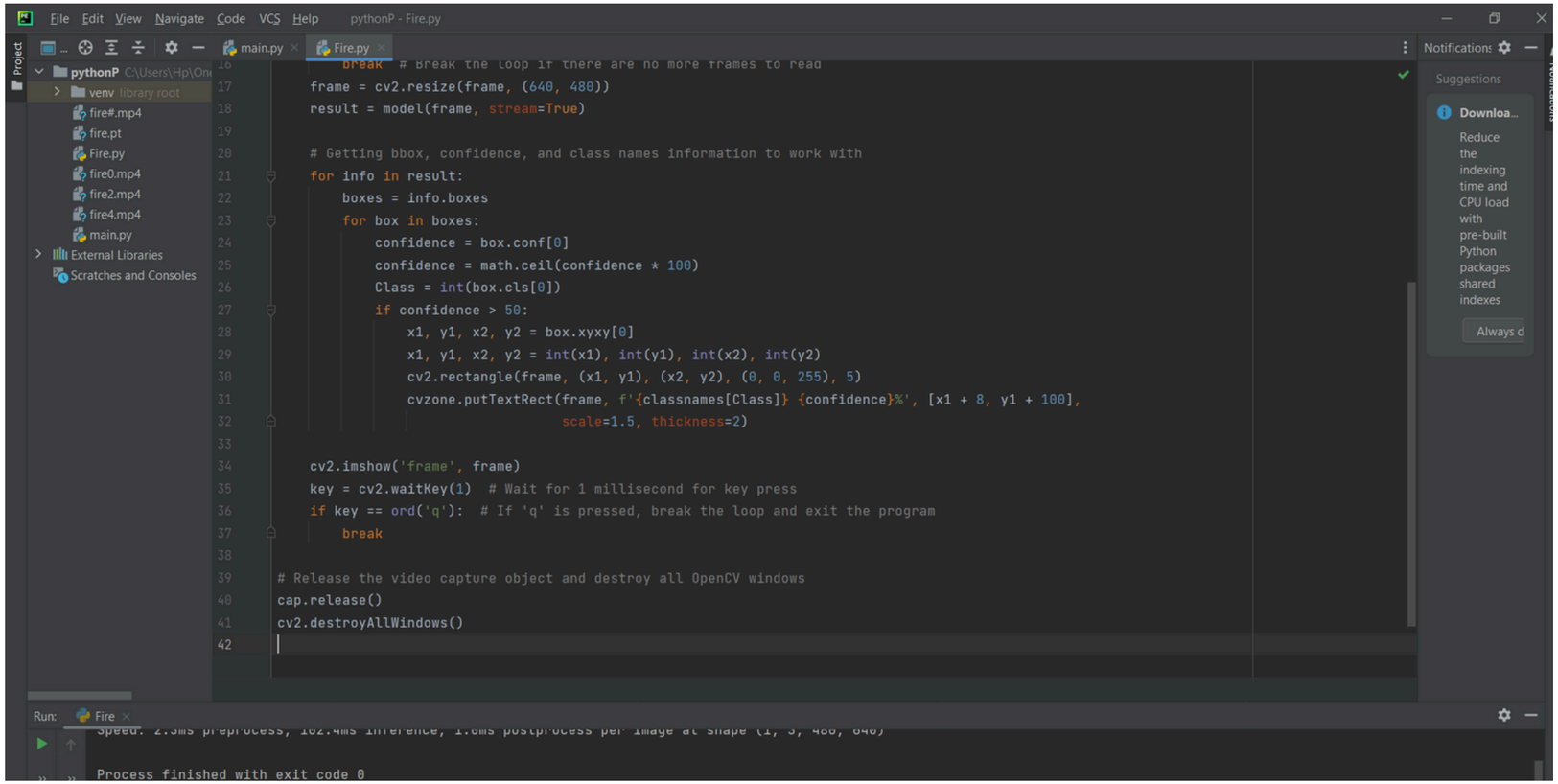
Project Evidence

Code of the fire flame detection using data model



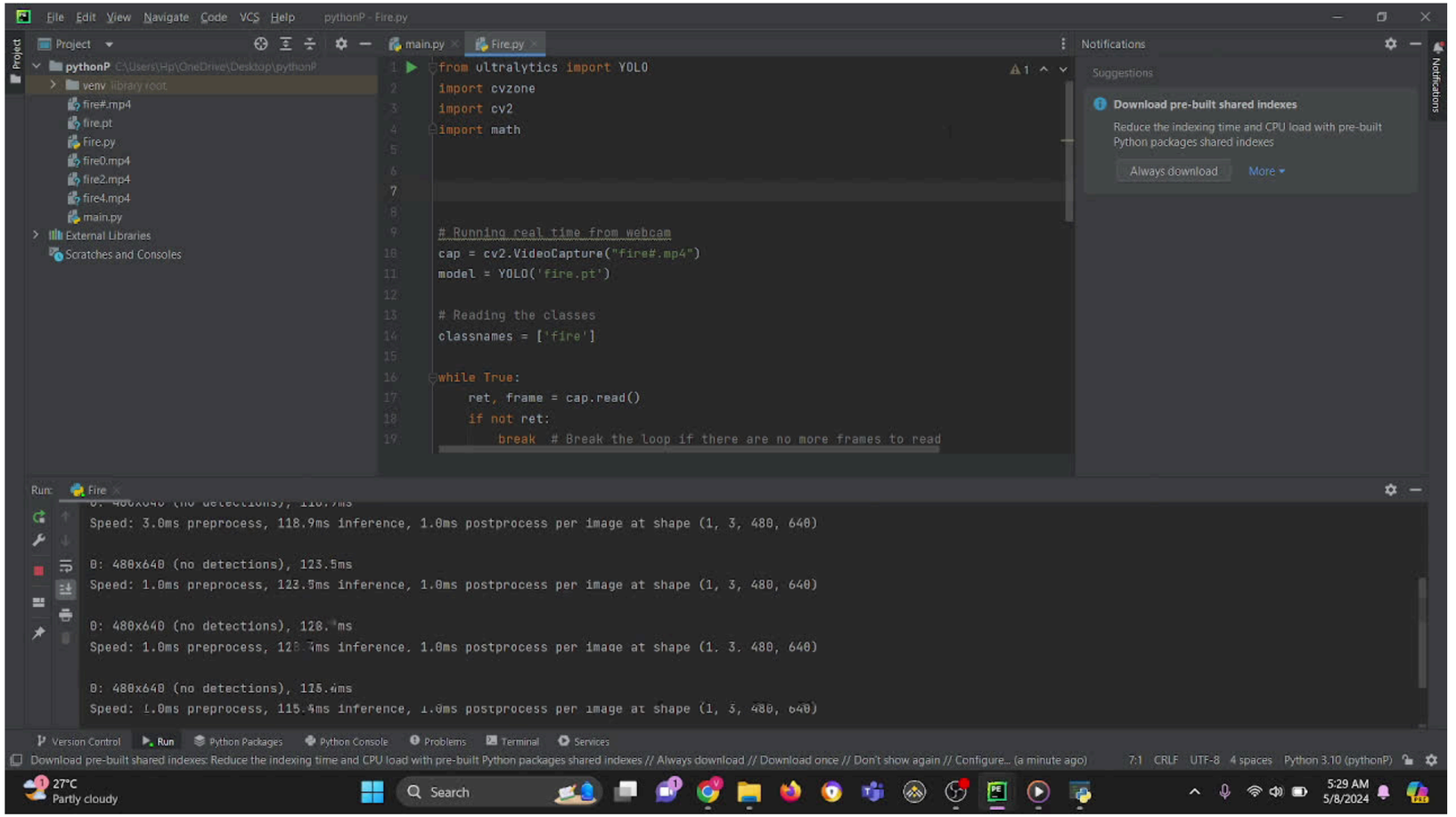
Project Evidence

Code of the fire flame detection using data model

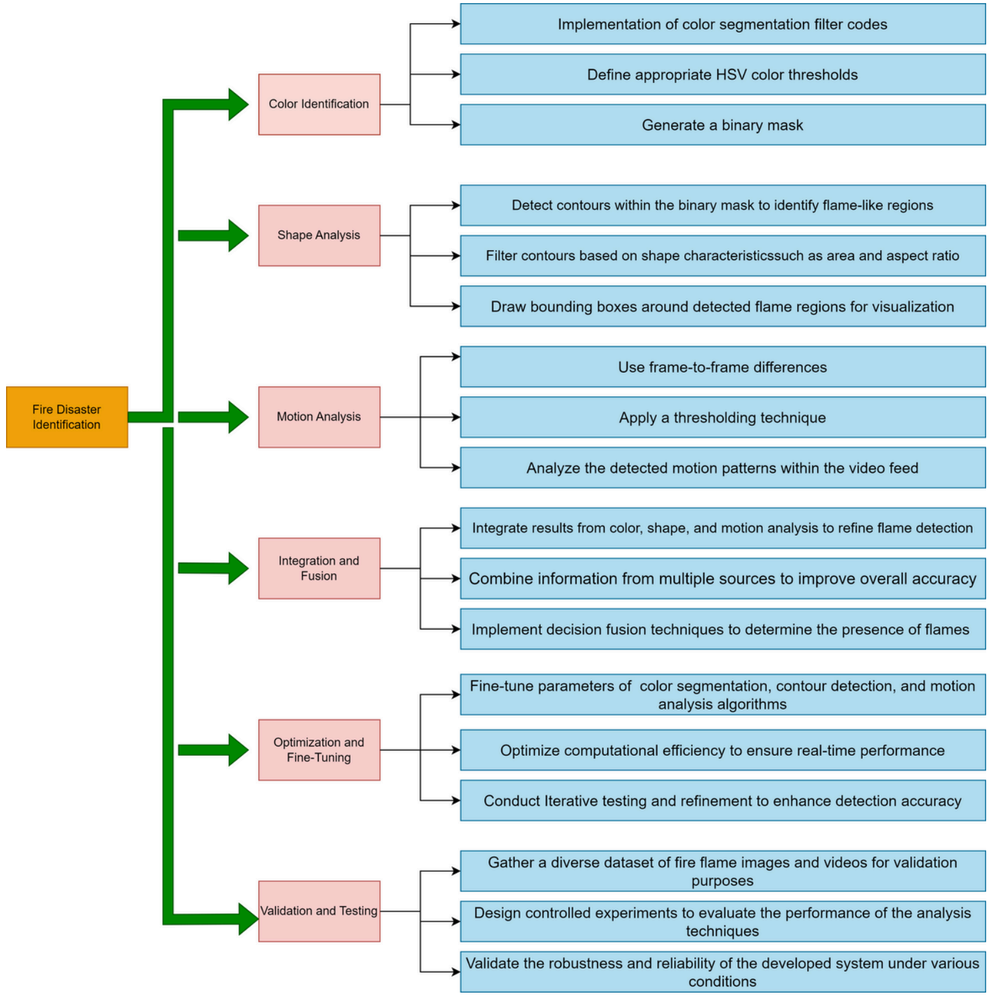


Project Evidence

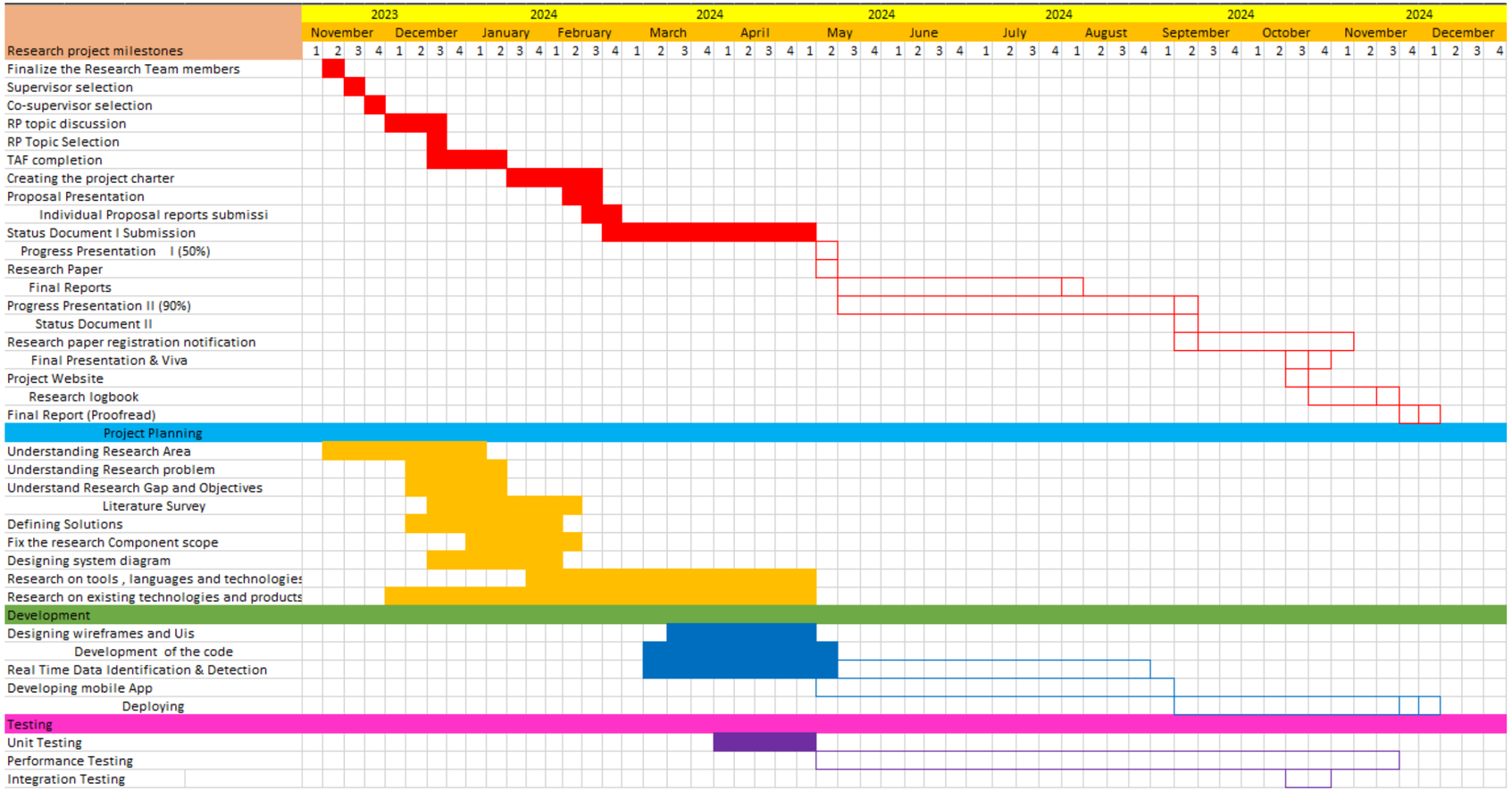
output of the fire flame detection using data model



Work Break Down Structure



Grant Chart


2023
2024
November
December
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May
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September
October
November
December
Research project milestones
Finalize the Research Team members
Supervisor selection
Co-supervisor selection
RP topic discussion
RP Topic Selection
TAF completion
Creating the project charter
Proposal Presentation
Individual Proposal reports submissi
Status Document I Submission
Progress Presentation I (50%)
Research Paper
Final Reports
Progress Presentation II (90%)
Status Document II
Research paper registration notification
Final Presentation & Viva
Project Website
Research logbook
Final Report (Proofread)
Project Planning
Understanding Research Area
Understanding Research problem
Understand Research Gap and Objectives
Literature Survey
Defining Solutions
Fix the research Component scope
Designing system diagram
Research on tools , languages and technologies
Research on existing technologies and products
Development
Designing wireframes and Uis
Development of the code
Real Time Data Identification & Detection
Developing mobile App
Deploying
Testing
Unit Testing
Performance Testing
Integration Testing

Project Completion

Completed Tasks

- ✓ Identify and detect fire using data model
- ✓ Identify fire using HSV colors
- ✓ Working on shape Analysis part

Tasks to be completed

- Motion analysis and shape analysis
- Integrate the computer vision techniques
- Identify the most effective method for disaster identification

References

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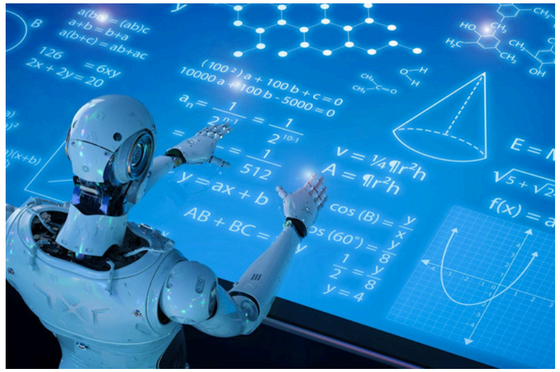
Rathnayaka R.M.S.T.

IT21101342

Specialization : Information Technology

Activation of the Rescue Mission

BACKGROUND



The background of a system or project typically refers to the context, history, and underlying factors that have led to its development or implementation. It provides an understanding of the problem or opportunity that the system aims to address and the reasons why it is necessary or beneficial.

RESEARCH QUESTION

How can computer vision and machine learning techniques be leveraged to enhance the accuracy and efficiency of real-time fire detection in outdoor environments?

RESEARCH GAP

Limited Integration of Robotic Systems

Current approaches to fire disaster response often lack efficient integration of multiple robotic units, leading to suboptimal coordination and resource utilization during rescue operations.

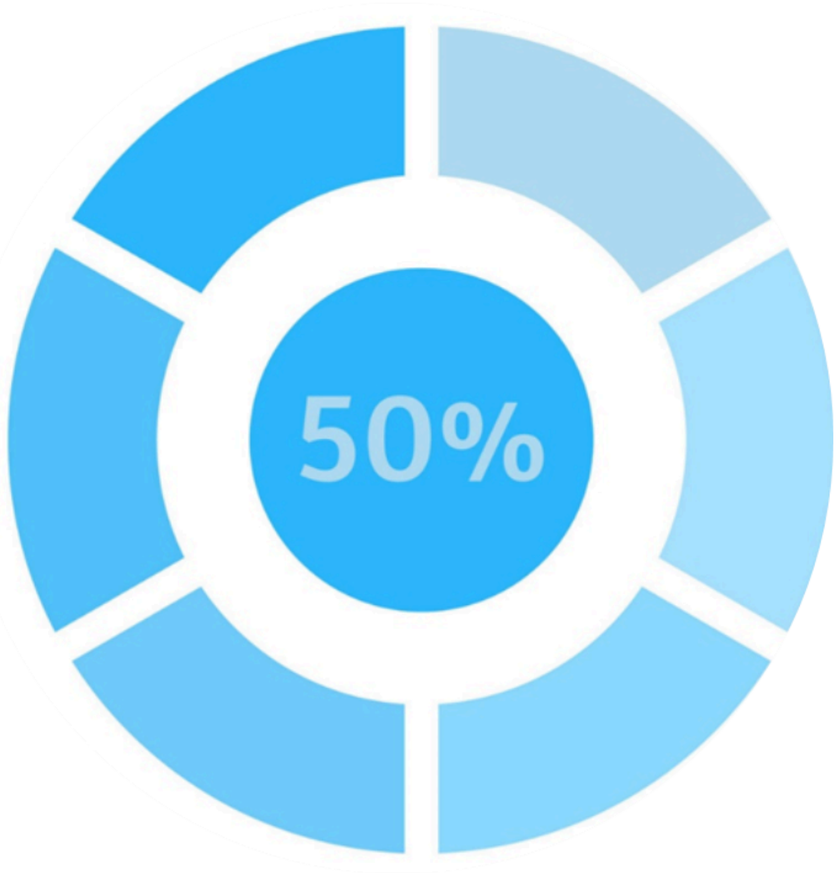
Inadequate Autonomous Decision-Making

Existing systems may rely heavily on human intervention for decision-making, resulting in delays and inefficiencies in response times, particularly in dynamic and unpredictable fire environments.

SPECIFIC AND SUB OBJECTIVES

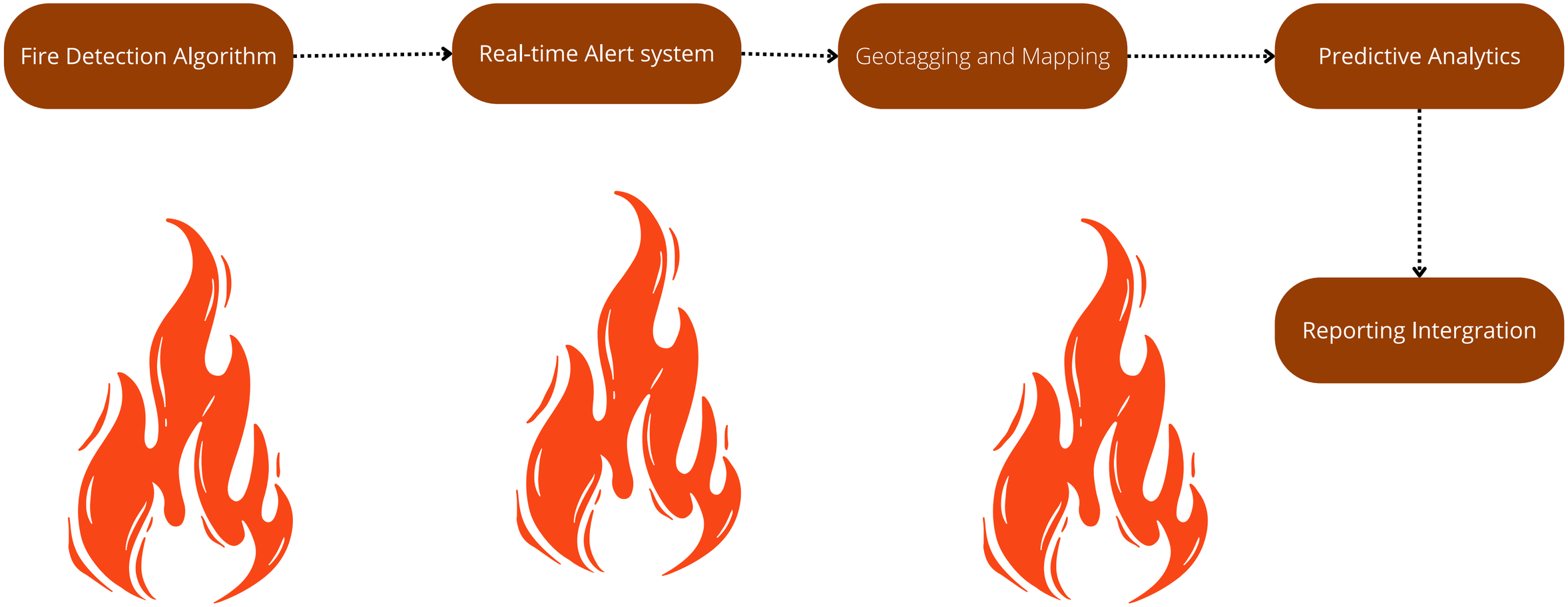
- Real-Time Data Analysis
- Geotagging & mapping
- Predictive Analytics
- Reporting Integrate

CURRENT PROGRESS



- Identify function
- 50% Implementations

SYSTEM DIAGRAM



Project Evidence

Create real-time alert

Activation_Rescue_Mission > Real_time_Alert.py > ...

```python
import smtplib
from email.mime.text import MIMEText
from email.mime.multipart import MIMEMultipart

# Define sender email
sender_email = 'sandunirathnayaka80@gmail.com'

def send_email_alert(sender_email, sender_password, recipient_email, subject, message):
    # Set up SMTP server
    smtp_server = 'smtp.example.com'
    smtp_port = 587  # Change to your SMTP port if different

    # Create email message
    email = MIMEMultipart()
    email['From'] = sender_email
    email['To'] = recipient_email
    email['Subject'] = subject
    email.attach(MIMEText(message, 'plain'))

    server = None
    try:
        # Connect to SMTP server
        server = smtplib.SMTP(smtp_server, smtp_port)
        server.starttls()  # Enable encryption
        # Login to sender's email account
        server.login(sender_email, sender_password)
```

```python
def send_email_alert(sender_email, sender_password, recipient_email, subject, message):
        # Connect to SMTP server
        server = smtplib.SMTP(smtp_server, smtp_port)
        server.starttls()  # Enable encryption
        # Login to sender's email account
        server.login(sender_email, sender_password)
        # Send email
        server.sendmail(sender_email, recipient_email, email.as_string())
        print("Email alert sent successfully!")
    except Exception as e:
        print("Failed to send email alert:", str(e))
    finally:
        # Close SMTP connection if it's open
        if server:
            server.quit()

# Usage
sender_password = 'Sandu1999#'
recipient_email = 'thakshilarathnayaka80@gmail.com'
subject = 'Fire Detected!'
message = 'A fire has been detected at the following location: Latitude: xx.xxxx, Longitude: yy.yyyy'
send_email_alert(sender_email, sender_password, recipient_email, subject, message)
```

```
[Running] python -u
"c:\Users\saduni\Desktop\fire-detection-system-in-python-opencv-main\fire-detection-system-in-python-opencv-main\Activation_Rescue_Mission\Real_time_Alert.py"
Failed to send email alert: [Errno 11001] getaddrinfo failed

[Done] exited with code=0 in 1.605 seconds
```

Create Geotagging & Mapping

```python
import requests

def update_map_with_fire_location(latitude, longitude):
    api_key = 'your_api_key'  # Replace 'your_api_key' with your actual Google Maps API key
    map_size = '400x400'  # Adjust map size as needed
    marker_color = 'red'
    marker_label = 'F'

    # Construct the URL for the static map image
    url = f'https://maps.googleapis.com/maps/api/staticmap?center={latitude},{longitude}&zoom=12&size={map_size}&mar

    # Send a GET request to the Google Maps Static API
    response = requests.get(url)

    # Save the map image to a file
    with open('fire_location_map.png', 'wb') as f:
        f.write(response.content)

    print("Map updated with fire location!")

# Usage
latitude = 37.7749  # Replace with the actual latitude of the fire location
longitude = -122.4194  # Replace with the actual longitude of the fire location
update_map_with_fire_location(latitude, longitude)
```

```
[Running] python -u
"c:\Users\saduni\Desktop\fire-detection-system-in-python-opencv-main\fire-detection-system-in-python-opencv-main\Activation_Rescue_Mi
ssion\Geotagging _Analytics.py"
Map updated with fire location!
```

Create Predictive Analytics

```python
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import numpy as np

def predict_fire_outbreak(weather_data, historical_fire_data):
    # Split data into features (weather_data) and target (historical_fire_data)
    X = np.array(weather_data).reshape(-1, 1)
    y = np.array(historical_fire_data)

    # Split data into training and testing sets
    X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

    # Create and train linear regression model
    model = LinearRegression()
    model.fit(X_train, y_train)

    # Make predictions
    y_pred = model.predict(X_test)

    # Evaluate model performance
    mse = mean_squared_error(y_test, y_pred)
    print("Mean Squared Error:", mse)

    # Example prediction
    new_weather_data = [[30]]  # Example: temperature of 30 degrees Celsius
    predicted_outbreak = model.predict(new_weather_data)
    print("Predicted fire outbreak probability:", predicted_outbreak[0])
```

```
    return model

# Usage
weather_data = [25, 28, 30, 35, 20, 22, 18]  # Example: temperature data
historical_fire_data = [0, 0, 1, 1, 0, 0, 0]  # Example: binary fire outbreak data (0=no fire, 1=fire)
predict_fire_outbreak(weather_data, historical_fire_data)
```

```
[Running] python -u
"c:\Users\saduni\Desktop\fire-detection-system-in-python-opencv-main\fire-detection-system-in-python-opencv-main\Activation_Rescue_Mission\Predictive_Analytics.py"
Mean Squared Error: 0.26994129068047323
Predicted fire outbreak probability: 0.7605769230769228

[Done] exited with code=0 in 11.541 seconds
```

Create Reporting Integrate

```python
from flask import Flask, request, render_template

app = Flask(__name__)

# Dummy data structure to store reported fire incidents
reported_incidents = []

@app.route('/')
def home():
    return render_template('index.html', incidents=reported_incidents)

@app.route('/report', methods=['GET', 'POST'])
def report_fire():
    if request.method == 'POST':
        location = request.form['location']
        description = request.form['description']
        reported_incidents.append({'location': location, 'description': description})
        return 'Fire incident reported successfully!'
    else:
        return render_template('report.html')

if __name__ == '__main__':
    app.run(debug=True)
```

Report Fire Incident

Location:

Description:

Submit

Reported Fire Incidents

{% for incident in incidents %}

- **Location:** {{ incident.location }} - **Description:** {{ incident.description }}

{% endfor %}

Report a Fire Incident

Requirement

Functional Requirement

- Fire Detection Algorithm
- Real-time Processing
- Alert Generation
- Localization of Fire
- Integration with Surveillance Systems:
- Scalability
- Configurability

Requirement

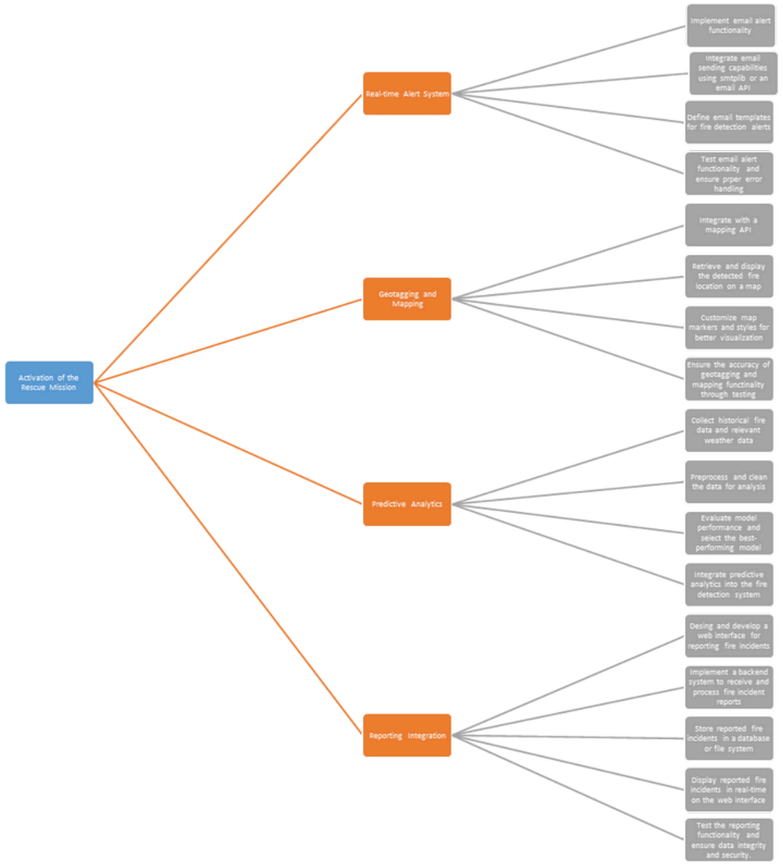
Non-functional Requirement

- Accuracy
- Speed
- Robustness
- Reliability
- Security
- Scalability
- Usability
- Maintainability
- Compliance

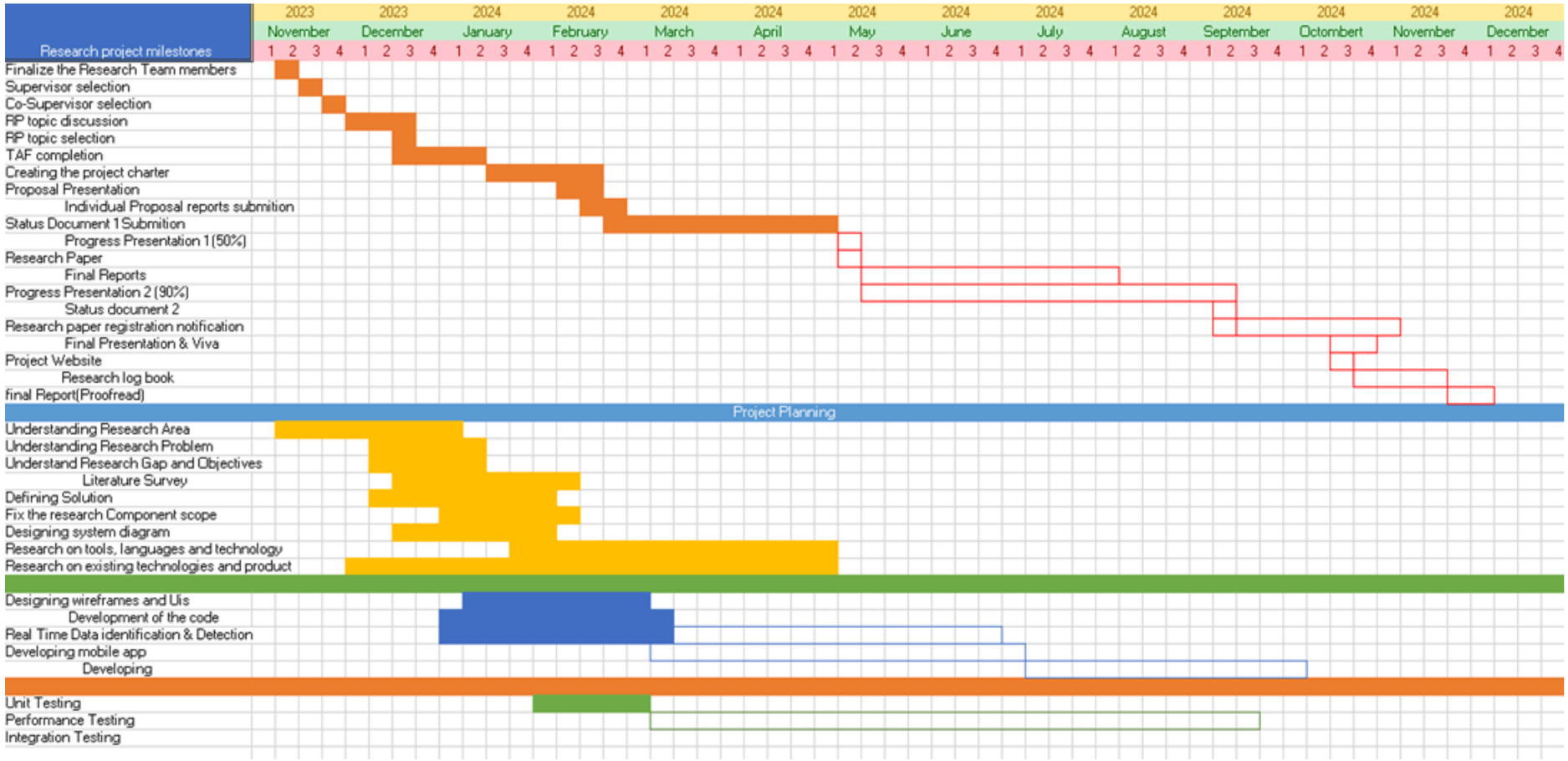
Technology

- **Frontend/ Backend**
  - Python
  - Jupyter Notebook
- **Libraries and Algorithm**
  - Machine Learning
  - Deep Q-network Algorithm
  - TensorFlow
  - NumPy, Pandas, Scikit-learn

Work Brake Down Structure



Gantt chat


2023 November
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2024 November
2024 December
Research project milestones
Finalize the Research Team members
Supervisor selection
Co-Supervisor selection
RP topic discussion
RP topic selection
TAF completion
Creating the project charter
Proposal Presentation
Individual Proposal reports submition
Status Document 1 Submition
Progress Presentation 1 (50%)
Research Paper
Final Reports
Progress Presentation 2 (90%)
Status document 2
Research paper registration notification
Final Presentation & Viva
Project Website
Research log book
final Report(Proofread)
Project Planning
Understanding Research Area
Understanding Research Problem
Understand Research Gap and Objectives
Literature Survey
Defining Solution
Fix the research Component scope
Designing system diagram
Research on tools, languages and technology
Research on existing technologies and product
Designing wireframes and Uis
Development of the code
Real Time Data identification & Detection
Developing mobile app
Developing
Unit Testing
Performance Testing
Integration Testing

References

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Conclusion

the proposed system presents a comprehensive approach to disaster response, combining decentralized communication, precise geolocation, ensemble-based disaster detection, and adaptive activation algorithms. Through innovative technologies and adaptive strategies, it enhances coordination, navigation, and response effectiveness, crucial for managing dynamic disaster scenarios with efficiency and resilience.

Thank You!!