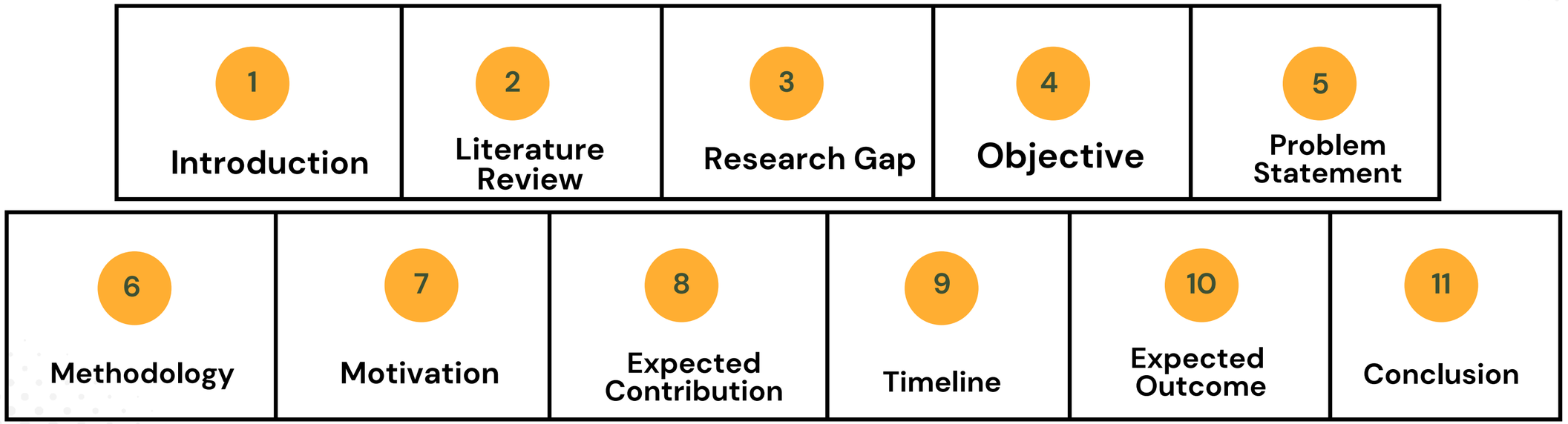
Overview


1
Introduction
2
Literature Review
3
Research Gap
4
Objective
5
Problem Statement
6
Methodology
7
Motivation
8
Expected Contribution
9
Timeline
10
Expected Outcome
11
Conclusion

Introduction

We want to make fire detection better, especially by finding fires early and improving the performance of our current systems.
One major challenge is that sometimes fire detectors give false alarms, which create many issues. Leveraging the power of Convolutional Neural Networks (CNNs), we aim to develop a more robust and effective model for detecting fires.

Literature Review

1.Early Indoor Fire Detection (Yusun et al. [1] Proposed) :

- YOLO based model for rapid fire detection within 8 seconds.
- Impressive recall (0.97), precision (0.91), and mAP0.5 (0.96) performance.

2.Three-Stage Fire Framework (Yavuz et al. [2] proposed):

- Comprehensive approach involving flame region extraction , motion analysis.
- And implements CNN models: Inception V3, SqueezeNet, VGG16, and VGG19.
- Achieves impressive accuracy ranging from 96.8% to 98.8% [2].

3.Improved Forest Fire Detection (Zhenyang et al [3] proposed) :

- YOLOv5 based enhancement by adding a very-small-target detection layer.
- Improvement of the original SPPF feature extraction module (three-layer Maxpool).
- Achieves a significant 10.1% improvement in mAP@0.5 compared to YOLOv5.

Literature Review

4.Object Identification Models for Fire Detection (Pu Li et al [4]):

- Proposed an image-based fire detection algorithm using advanced object identification CNN models(Faster-RCNN, R-FCN, SSD, YOLOv3).
- YOLOv3 is highlighted as the fastest and most robust among these models.
- YOLOv3 achieves an impressive average precision of 83.7% [4].

5.Vision-Based AI for Indoor Fire and Smoke Detection (James Pincott et al. [11])

- Utilized SSD MobileNet V2 and Faster R-CNN Inception V2 models.
- Faster R-CNN Inception V2 exhibited superior performance.
- Noted a significant rate of false fire alarms (41% of total incidents) in fire services' responses.

Research Gap

1. Limited focus on indoor fire detection; applicability to outdoor environments is not discussed.
2. Limited focus on exploring improved deep learning models for achieving higher accuracy.
3. Lack of access to larger, diverse datasets essential for robust model training.
4. Limited investigation into effective strategies for reducing false fire alarms.
5. Scarcity of research addressing the real-time integration of AI-based fire detection systems.

Objective

The primary objective of this thesis project is to advance the field of fire detection with the following specific goals:

1

To Enhance Early Detection , Increase Accuracy and Minimize False Alarms

2

To Evaluate and Enhance Algorithm Performance for Adaptive Fire Detection

Problem Statement

Fires are becoming a bigger problem in our cities, and they can be really harmful. The issue is that our current fire detectors are slow to find fires and sometimes make mistakes by giving false alarms. The main problem is that we don't have a complete CNN-based fire and smoke detection system that works well both inside and outside.We need this system to keep us safe from fires.

Methodology

1 - Data Collection:

In this phase we will train our chosen fire detection model using a dataset which includes images of fires and non-fires

3 - Model Selection:

In the model training and development phase, we will train our chosen fire detection model using a dataset which includes images of fires and non-fires

5 - Comparison with Existing Approaches

This involves measuring accuracy assessing efficiency through inference time, addressing false alarms, comparing our model , proposing future improvements.

The first step involves the collecting dataset of fire images, encompassing a wide range of fire types, environments, and conditions

2 - Data Preprocessing

In the model selection phase we're considering established object detection architectures for our fire detection system

4 - Model Training and Development

In this stage, we will compare the performance of our selected models with existing fire detection methods,

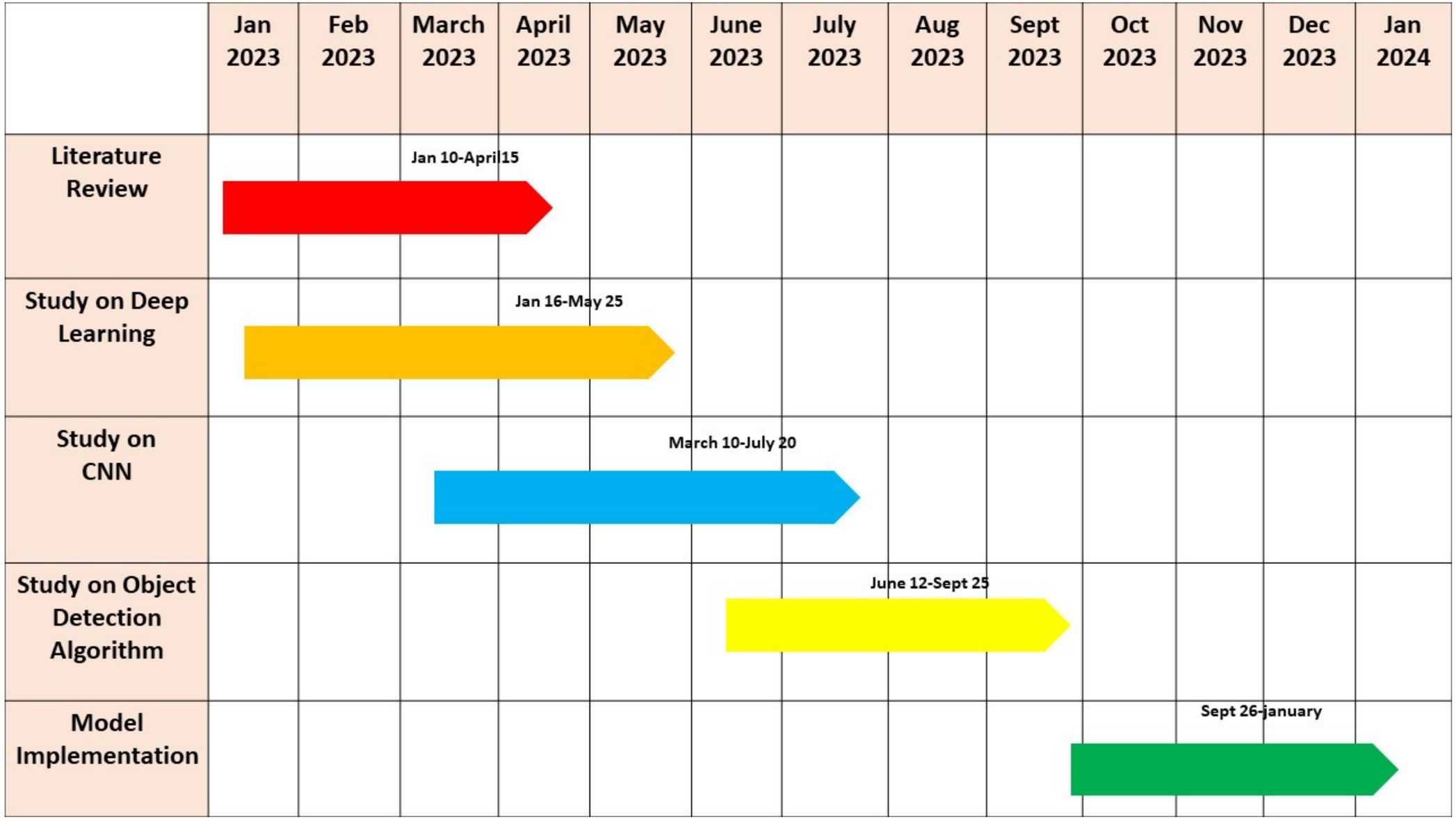
6 - Performance Analysis

Motivation

Expected Contribution

1. To Improved Early Fire Detection Algorithm
2. Minimization of False Alarms
3. Contribution to Fire Safety

Timeline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Aug 2023
Sept 2023
Oct 2023
Nov 2023
Dec 2023
Jan 2024
Literature Review
Jan 10-April15
Study on Deep Learning
Jan 16-May 25
Study on CNN
March 10-July 20
Study on Object Detection Algorithm
June 12-Sept 25
Model Implementation
Sept 26-january

Expected Outcome :

1

To attain measurable and substantial improvements in fire detection using CNNs

2

Our aim is to make the system much better at --

- Identifying fires
- Reducing false alarms
- Crucial for different environments

Conclusion

In conclusion, our proposal carries the potential to make a significant positive impact on society. By using CNNs, we aim to enhance accuracy, reduce false alarms, and contribute to saving lives and property.

Reference

1. H. C. Yusun Ahn a, "Development of early fire detection model for buildings using computer vision-based CCTV," Journal of Building Engineering, vol. 65, p. 647, april 2023. 2. https://doi.org/10.1016/j.jobe.2022.105647

2. M. K. Yavuz Selim Taspinar1, "171 Fire Detection inImages Using FrameworkBased on Image Processing, Motion Detection and Convolutional Neural Network," INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING, vol. 9, p. 171–177, 2021. https://doi.org/10.18201/ijisae.2021473636

3. H. L. Zhenyang Xue 1, "A Small Target Forest Fire Detection Model Based on YOLOv5 Improvement," Multidisciplinary Digital Publishing Institute, vol. 13, 2022. https://doi.org/10.3390/f13081332

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5. P. W. T. James Pincott, "Indoor fire detection utilizing computer vision-based strategies," Journal of Building Engineering, vol. 61, December 2022. https://doi.org/10.1016/j.jobe.2022.105154

THANK YOU