IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

Smart Fire Detection System using Python and OpenCV

Prof. Samita Patil[1], Omkar More[2], Aditya Jambhale[3], Sudesh Jadhav[4]
Faculty of Department of Computer Engineering[1]
Student Of Department of Computer Engineering[2,3,4]
Shivajirao S Jondhale College of Engineering, Dombivli (E),Thane, Maharashtra, India

Abstract: *Detecting fires is essential to maintaining safety in a variety of contexts, such as homes, workplaces, and industries. In this project, we describe the creation and deployment of an Internet of Things (IoT)-based fire detection system that combines machine learning with picture capturing capabilities. The system uses an Internet of Things (IoT) camera to capture photos of its environment, which are then processed by a convolutional neural network (CNN) that is particularly made to detect fire. Using visual clues, the CNN model analyzes the photos in real time to detect possible fire threats. The system sends out an alarm when a fire is detected, allowing for quick action and mitigation. Safety is improved by remote monitoring and early fire event detection made possible by the combination of IoT technologies and machine learning algorithms .and reducing any harm. The experimental results confirm the effectiveness and reliability of the suggested technique in accurately detecting fire incidents. By providing a scalable and effective way to improve safety in a variety of settings, this initiative advances fire detection technology.*

Keywords: Fire detection, Computer vision, OpenCV, Python, Machine

I. INTRODUCTION

1.1 Overview

Fires pose severe risks, potentially leading to substantial loss of life and property. Annually, thousands of fire-related incidents occur globally due to factors like power outages, accidental ignitions, and natural lightning strikes. To address fire risks, various detection systems have been designed and are in active use. Traditional systems such as smoke detectors and sprinkler systems identify fires through smoke and activate when specific temperature levels are reached. Nevertheless, these conventional methods have drawbacks, including false alarms, limited coverage, transmission problems, and delayed alerts. Since smoke detectors are typically mounted on ceilings, it takes time for smoke to ascend, causing delays in detection. Furthermore, implementing these systems in open spaces and large structures like stadiums and aircraft hangars can be challenging due to their extensive coverage requirements. Adopting image processing technology for fire detection brings numerous advantages, especially in high-heat and temperature-prone environments where fire risks are elevated. This technology enables continuous monitoring of high-risk areas.

1.2 Problem Definition and Objectives

Detecting fires in different settings, such as homes, industries, and forests, is essential for safety and disaster prevention. Conventional fire detection methods typically depend on smoke detectors or thermal sensors, which may be restricted in their range and efficiency. The goal is to create an intelligent fire detection system that employs computer vision methods to scrutinize live video feeds and accurately detect indications of fire or smoke. This innovative system aims to reduce false alarms while improving response times during emergencies.

II. LITERATURE REVIEW

Computer vision-based fire detection systems are becoming more and more popular, according to the literature currently in publication. To increase the precision and effectiveness of detection, researchers have investigated a

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

number of methods, such as color segmentation, texture analysis, and machine learning algorithms. These studies demonstrate how computer vision technology may be used to improve fire safety protocols.

Disadvantages of Existing System

- Response Time.
- Maintenance Requirement.
- Manual

Proposed System:

The suggested system detects fires in real time using Python and OpenCV. It analyzes video streams using computer vision methods including feature extraction, preprocessing, and machine learning classification. The device improves safety in a variety of settings by sending out notifications for prompt action in the event of a fire or smoke.

Focal Points for Fire Detection System Using Python and OpenCV:

- Real-time Monitoring
- Computer Vision
- Techniques Early
- Warning System
- Cost- effective Solution
- Safety Measures
- Scalability
- Machine Learning Algorithms

III. METHODOLOGY

"To create the system for detecting fires" We were meticulous in our use of Python and OpenCV.

- Gathering Data: Gather a variety of video footage from different locations that depicts both fire and non-fire scenarios.
  Preprocessing: To improve relevant elements, preprocess video frames using techniques including color segmentation, noise reduction, and image improvement.
- Utilize preprocessed frames to extract discriminative information, such as color histograms, motion characteristics, and texture descriptors.
- Creation of Machine Learning Models: Convolutional Neural Networks (CNN) and Support Vector Machines (SVM) are two examples of machine learning models that are trained using extracted attributes to classify frames as either fire or non-fire.
- Model Evaluation: Use metrics such as accuracy, precision, recall, and others to evaluate the model's performance on an alternative validation dataset.
- Integration of the System: Include the learned model in

IV. SYSTEM DESIGN

4.1 System Components

A camera or video feed will be used by the Smart Fire Detection System to keep an eye out for potential fire threats. In order to identify smoke or fire and sound an alarm or alert, the system will examine the video frames. Python may be used to integrate the entire workflow and OpenCV can be used to process images in this system.

Hardware Elements:

1. Camera

A CCTV or IP camera to record still photos or live video.
The accuracy of detection is impacted by camera resolution and frame rate.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

The camera must to be positioned to cover the most susceptible regions.

2. Processor: A computer to execute the detection algorithms, such as a PC, Raspberry Pi, or comparable device.

There should be enough processing capability in the CPU to effectively handle real-time video frames.

1. Alarm/Notification System: The system has the ability to send an email, text message, or push notification in the event that fire or smoke is detected.As an alternative, the system has the ability to activate sirens and other physical alerts.

2. Optional Sensors: Additional information from temperature and smoke sensors can increase precision and lower false positives. To verify detection, these sensors can be used in conjunction with the visual fire detection system.

Components of software:

1. Environment for Python: The primary language used to implement the system is Python.

You may utilize libraries like TensorFlow/PyTorch (for deep learning-based models) and OpenCV (for image processing).

2. OpenCV: OpenCV will be utilized for frame analysis, fire or smoke detection, and video feed processing. Techniques like color-based segmentation, contour detection, and object tracking can be implemented to identify fire in the frame.

3. Machine Learning (optional): If a deep learning model is being used, a pre-trained model for fire detection (e.g., CNNs) can be loaded and used for classification.

The model can be fine-tuned with custom datasets for higher accuracy.

4. Notifications: A Python script for sending alerts when fire or smoke is detected

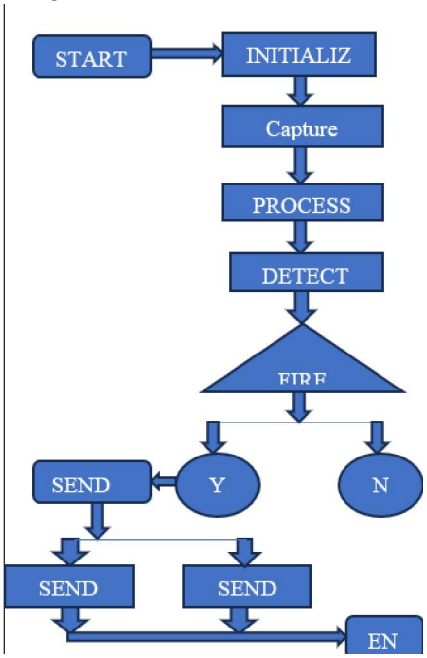

Figure 4.2 Block Diagram

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

V. RESULTS & ANALYSIS

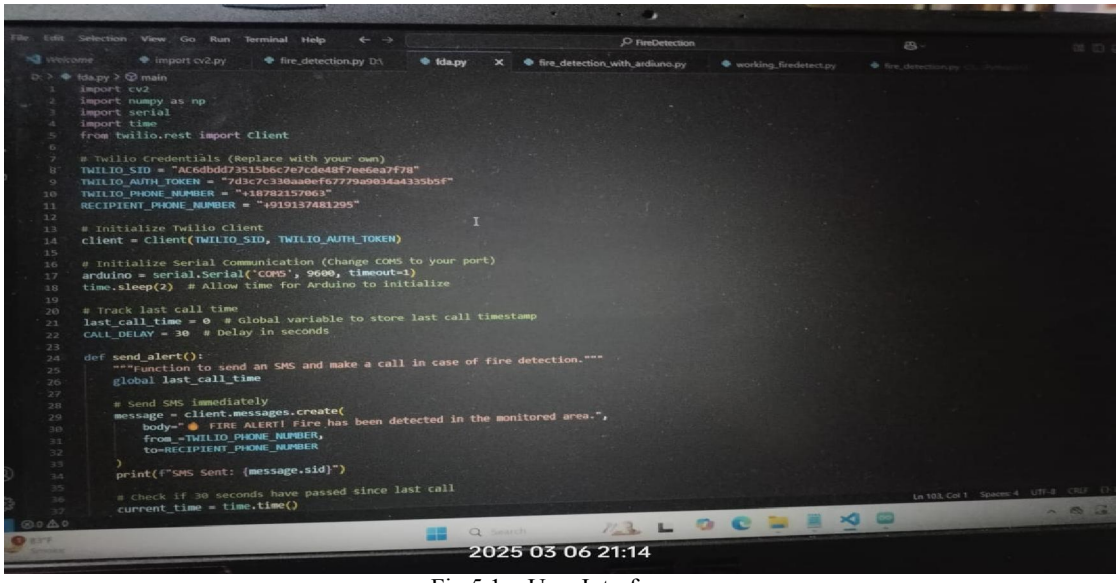

Fig 5.1 : User Interface

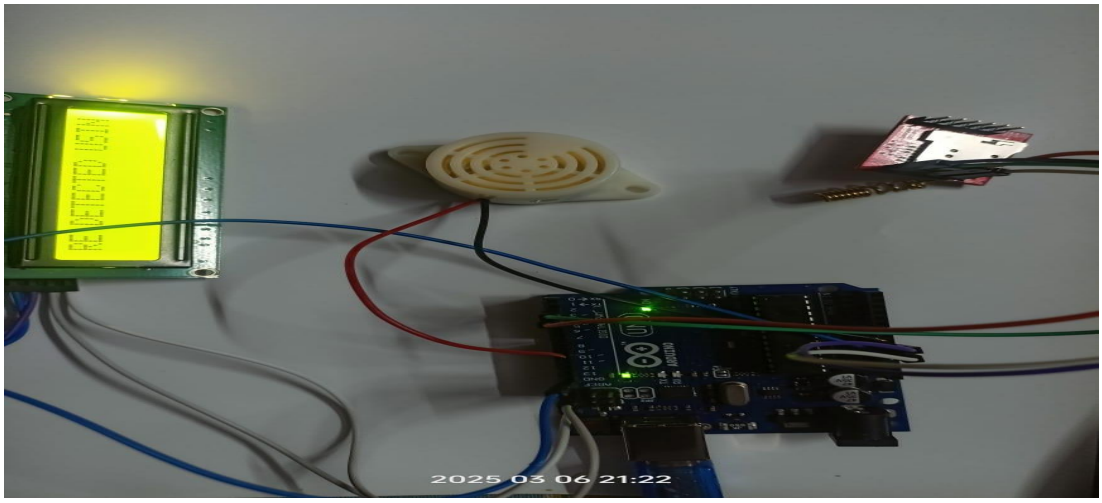

Fig 5.2 : Fire Detection Model

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

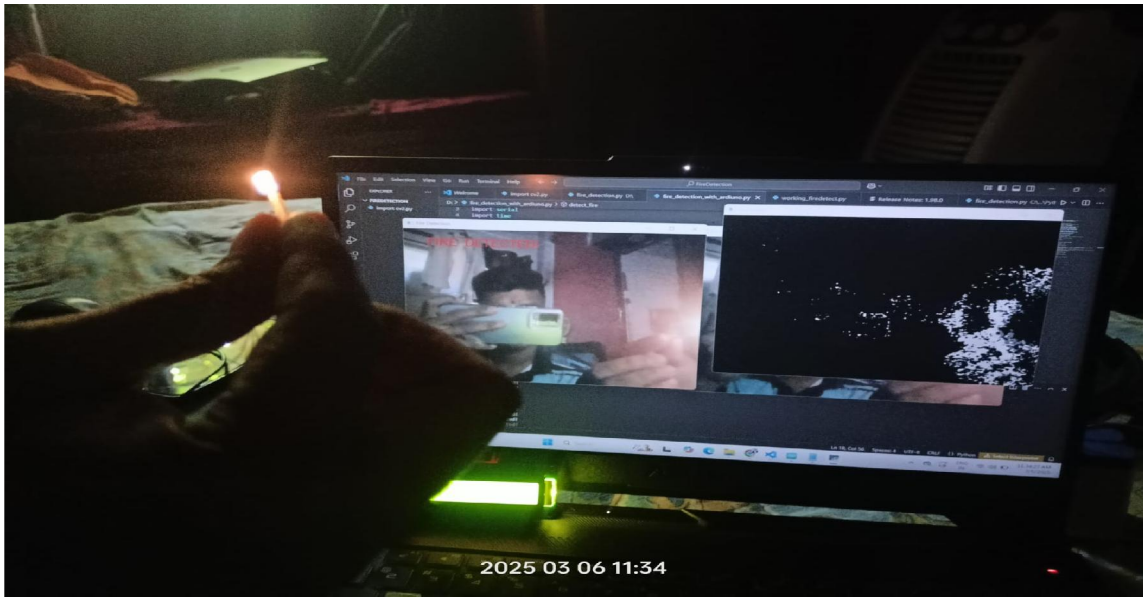

Fig 5.3 : Fire Detected In Webcam

Fig 5.4 :Call Alert

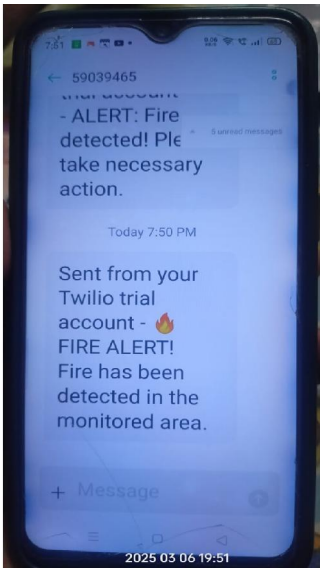

Fig 5.5 : Sms Alert

VI. CONCLUSION

Conclusion

In summary, the project's goal was to identify fires using a novel method as opposed to relying on an already-existing system. In order to stay up with the latest technological advancements and reduce their limits, a new system has been developed. These restrictions can be lessened by employing image processing technology to detect fires. This is because the camera in this system functions similarly to a human eye, capturing video and analyzing the picture using software that alerts the user. It may be utilized in any location, such as a hospital, train station, woodland, etc. Fire is successfully detected by the intended prototype. provides the algorithm, test, result, review, analysis, and system design.We don't utilize technologies like smoke detectors at the moment.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

REFERENCES

[1] Zhang, Z., Zhang, C., Li, Q., & Sun, S. (2019). A Survey of Recent Advances in Fire Detection using Computer Vision Techniques. arXiv preprint arXiv:1909.1016

[2]Sharma, P., Bhatia, R., & Gupta, S. (2020). Fire Detection System Using Machine Learning Algorithms: A Review. In Proceedings of the International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (pp.463473). Springer, Singapore.

[3]Prasad, S., Kulkarni, V., Deshpande, S., &Waghmode, V. (2020). An Analysis of Fire Detection Techniques using Cpision and M ComuterVachine Learning Algorithms. In Proceedings of the International Conference on Advances in computing and Data Sciences (pp. 251-258). Springer, Singapore

OpenCV documentation: https://docs.opencv.org/

[4]Chowdhury, M. E. H., & Rahaman, M. M. (2020). A Comprehensive Review of Fire Detection Systems Using Image Processing Techniques. SN Computer Science, 1(5), 1-20.

[5]Zhang, Y., & Xia, Z. (2018, October). Research on the image segmentation based on improved threshold extractions. In 2018 IEEE 3rd International Conference on Cloud Computing and Internet of Things (CCIOT) (pp. 386-389). IEEE.

[6]Tran, N. B., Tanase, M. A., Bennett, L. T., & Aponte, C. (2019, October). Fire-severity classification across temperate Australian forests: random forests versus spectral index thresholding. In Remote Sensing for Agriculture, Ecosystems, and Hydrology XXI (Vol. 11149, pp. 255-267). SPIE.

[6]Smith, L. N. (2018). A disciplined approach to neural network hyper-parameters: Part 1--learning rate, batch size, momentum, and weight decay. arXiv preprint arXiv:1803.09820.

[7]Wong, S. C., Gatt, A., Stamatescu, V., & McDonnell, M. D. (2016, November). Understanding data augmentation for classification: when to warp?. In 2016 international conference on digital image computing: techniques and applications (DICTA) (pp. 1-6). IEEE.

[8]Shorten, C., &Khoshgoftaar, T. M. (2019). A survey on image data augmentation for deep learning. Journal of big data, 6(1), 1-48.

[9]Cubuk, E. D., Zoph, B., Mane, D., Vasudevan, V., & Le, Q. V. (2019). Autoaugment: Learning augmentation strategies from data. In Proceedings of the IEEE/CVF conference on computer vision and pattern recognition (pp. 113-123).

[10]Chandra V, Vamshi K, Praseeda A, Venkateswarlu C (2022), Brightness control with hand gestures. The International journal of analytical and experimental modal analysis.15(12): 513 -516.

[11]Dehong, C., Liangqi, Z., Pengpeng, S., Zaiyang, T., Yuhao, M., & Yong, W. (2017, May). Design and implementation of LiDAR navigation system based on triangulation measurement. In 2017 29th Chinese Control And Decision Conference (CCDC) (pp. 6060-6063). IEEE.

[12]AshifuddinMondal, M., &Rehena, Z. (2018, January). Iot based intelligent agriculture field monitoring system. In 2018 8th International Conference on Cloud Computing, Data Science & Engineering (Confluence) (pp. 625-629). IEEE

[13]Shiva J, Palanivel S., Venkateswarlu C.(2022). Paddy Crop Leaf Disease Classification By Using CNN And Transfer Learning Approach. Journal For Basic Sciences. 22(12):77-86.

[14]N. Dziengel, G. Wittenburg, and J. Schiller, "Towards distributed event detection in Wireless Sensor Networks," in Adjunct Proc. of 4th IEEEfACMIntI. Conf. on Distributed Computing in Sensor Systems (DCOSSa:AZ'08), Santorini Island, Greece, 2020.

[15] S. Jarupadung, "Distributed event detection and semantic event processing," in The 6th ACM International Conference on Distributed Event- Based Systems (DEBS 2020)(Doctoral Symposium), 2020.

[16]Y. Li and L. E. Parker, "Detecting and monitoring time-related abnormal events using a Wireless Sensor Networks and mobile robot," in Intelligent Robots and Systems, 2019. IROS 2019. IEEEfRSJ International Conference on. IEEE, 2019.

[17] Zahraa Shihab Al Hakeem, HawaraaH.Abass, Haider Ismael Shahadi, “An Automatic System for Detection of Fires in Outdoor Areas” in IEEE Access. DOI: 10.1109/ICECET55527.2022.9872883

[18] “Real time Smoke and fire warning detection method based on an improved YOLOv5 model” paper by Shuyan Liu, Jianbin Fing. DOI:10.1109/PRAI55851.2022.9904105

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 1, March 2025

[19] G. Sathyakala and V. Kirthika, B. Aishwarya, “Computer Vision Based Fire Detection with a Video Alert System” in IEEE Access. DOI: 10.1109/ICCSP.2018.8524216
[20] Ti Nguyen-Ti; Thuan Nguyen-Phuc; Tuan Do-Hong. “Fire detection based on video processing method” in IEEE Access. DOI: 10.1109/ATC.2013.6698087
[21] Bibek Shrestha, “Fire Detection Using Image Processing” in Metropolia University of Applied science.
[22] Aman Kumar, Flavia D Gonsalves, “Computer Vision Based Fire Detection System Using OpenCV - A Case Study”, in Research & Review: Machine Learning and Cloud Computing at Matjourals.
[23] N. Dziengel, G. Wittenburg, and J. Schiller, "Towards distributed event detection in Wireless Sensor Networks," in Adjunct Proc. of 4th IEEEfACMIntI. Conf. on Distributed Computing in Sensor Systems (DCOSSa:AZ'08), Santorini Island, Greece, 2020.
[24] S. Jarupadung, "Distributed event detection and semantic event processing," in The 6th ACM International Conference on Distributed Event- Based Systems (DEBS 2020)(Doctoral Symposium), 2020.
[25] Y. Li and L. E. Parker, "Detecting and monitoring timerelated abnormal events using a Wireless Sensor Networks and mobile robot," in Intelligent Robots and Systems, 2019. IROS 2019. IEEEfRSJ International Conference on. IEEE, 2019