Project Proposal Reference No. : 46S_BE_4465
Project Title : FOREST FIRE DETECTION USING MACHINE LEARNING
College : Sir M. Visvesvaraya Institute of Technology
Department : Computer Science and Engineering

Submitted By:
M SHREYA 1MV19CS066
RISHITA GOYAL 1MV19CS093
SUDHIKSHA R. 1MV19CS106
TANYA P. BOBICHAN 1MV19CS112
Guide :
Dr. SREENIVASA B. C.
Associate Professor
Dept. Of CSE

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Introduction:
A forest fire is an unplanned fire that breaks out in a wilderness setting like a forest or prairie. Forest fires have proven to be a threat to humans and wildlife creatures. Early detection of forest fires will decrease the severity preventing huge loss of ecosystems and its effect on global conditions. The forest fire predictive model that is developed can be set up to analyze and process images from security cameras, drones, and satellites. Dataset consisting of various images of forests and surroundings resembling forests is used and the images are classified into two categories: “ fire ” and “ smoke ”. To identify the existence or onset of a forest fire in an image efficiently, machine learning techniques and deep-learning models are created and trained. In this project, we propose a forest fire detection system that utilizes Haar Cascade and YOLOv5 for real time detection. Further the nearest authorities will soon be informed after the specifics of the incident are known.

Objectives:
Forest fires have become an environmental concern in recent years all over the world, posing a threat to human life and property and to the area’s natural environment. Forest fires can impact the economy as many families and communities depend on the forest for food, fodder and fuel. The objectives include :

- This project aims at building a machine learning model that predicts whether there is an active fire, no fire, or if a fire is about to start by processing an image of a forest.

- Leverage Computer Vision to keep an eye on forests by identifying areas of high risk and providing a proactive system to alert resources to changes in the ecosystem.
- It also aims at early detection of wild forest fires that can reduce their severity and can help predict behavior. This is advantageous for regulating the fire as well as from a resource allocation perspective.
- Sending the corresponding messages to the concerned authorities so that necessary actions can be taken to control early forest fires and thereby reducing the damage it causes.

Methodology:

YOLOv5 and Haar Cascade are two popular object detection algorithms used for forest fire detection. Haar Cascade is a machine learning-based object detection algorithm that uses a series of Haar-like features to detect objects in images.While it is less accurate than YOLOv5, it is still a viable option for forest fire detection, particularly in areas with limited computational resources. YOLOv5 is a state-of-the-art object detection algorithm that uses deep learning to detect objects in real-time. It is known for its accuracy and speed, making it an ideal choice for forest fire detection. By training YOLOv5 on a dataset of forest fire images, it can accurately detect and fire, smoke, and other features related to forest fires.

The proposed system, Forest Fire Detection, using YOLO it detects fire or smoke and sends the corresponding message so that necessary actions can be taken to control early forest fires and thereby reducing the damage it causes. The proposed model gives 94% accuracy in detecting the fire or smoke environments used, and the images will be classified into two categories: 'fire' and 'smoke'. The proposed system will extract features and then be fed into the YOLOv5 model for object detection and classification, specifically identifying regions of the image containing forest fires. The system will generate real-time alerts and warnings to relevant authorities and stakeholders, enabling swift and effective response to forest fires. YOLOv5 for detection and classification is expected to result in a robust and efficient forest fire detection system with high accuracy and real-time capability. The system has the potential to significantly enhance forest fire management and prevention efforts, contributing to the protection of forests, wildlife, and human lives.

Results and Conclusion:

The proposed system has a lot of potential and benefits, playing a crucial role in the protection of a healthy ecosystem which could otherwise put wildlife in danger, compromise air quality, and jeopardize the safety of all communities. Extensive testing of interactions of models on the datasets are performed to get the best models for final system integration. The proposed system mainly aims to create an effective and efficient algorithm for detection and prevention of wildfire by promptly alerting the responsible authorities.

YOLOv5 is generally considered to be more accurate than Haar Cascade due to its deep learning approach giving 94% accuracy YOLOv5 can detect smaller fires and fire-related features with higher accuracy, while Haar Cascade may struggle to detect smaller fires. YOLOv5 is a deep

learning-based algorithm that is trained on large datasets and can detect objects in multiple classes with high precision. It uses a single neural network to detect and classify objects, making it faster than the Haar cascade which requires multiple stages of computation. Additionally, YOLOv5 is more robust to variations in lighting, orientation, and scale, which can affect the accuracy of Haar cascade. Regarding speed, YOLOv5 is faster than Haar Cascade, particularly when it comes to real-time detection. YOLOv5 can process more images per second, making it a more suitable option for applications that require real-time detection, such as forest fire monitoring.

Future Scope:

- In the future, there is potential to integrate additional technologies such as unmanned aerial vehicles (UAVs) and Internet of Things (IoT) devices to enhance the system's capabilities.
- UAVs can provide real-time aerial imagery, and IoT devices can collect data on environmental factors such as temperature and humidity.
- By integrating these technologies, the forest fire detection system can provide a more comprehensive and accurate assessment of the situation, which can help to prevent fires from spreading and minimize damage to the environment and human lives
- Automated Alert and Notification Systems: Forest fire detection systems using YOLOv5 can automate the process of generating alerts and notifications. When a fire is detected, these systems can instantly trigger notifications to relevant authorities, nearby communities, and emergency services, facilitating a prompt response and minimizing damage.
- Advanced Fire Behavior Analysis: YOLOv5 can be utilized to not only detect forest fires but also analyze fire behavior. By analyzing the movement, size, and spread of fire using these algorithms, it becomes possible to predict fire behavior and provide valuable insights for firefighting strategies and evacuation plans.
- Multi-sensor Integration: Forest fire detection systems can be enhanced by integrating data from multiple sensors such as thermal cameras, weather sensors, and satellite imagery. YOLOv5 can effectively analyze and fuse information from various sources, providing a comprehensive understanding of fire dynamics and aiding in early detection.