A

PROJECT REPORT

On

"AI-ML BASED INTELLIGENT DE-SMOKING/DE-HAZING ALGORITHM"

Submitted to

S. B. Jain Institute of Technology, Management & Research, Nagpur

An Autonomous Institute,

Affiliated to Rashtrasant Tukadoji Maharaj Nagpur University

Department of Emerging Technologies

Bachelor of Technology (B. Tech)

Submitted By

1. **Priya Yadav, AM21008**
2. **Anshul Chore, AM21050**
3. **Shrutika Tabhane, AM21060**
4. **Sumit Sonar, AM22D003**

Guided By

Prof. Alok Chauhan

S. B. JAIN INSTITUTE OF TECHNOLOGY, MANAGEMENT AND RESEARCH, NAGPUR

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ABSTRACT

The integration of intelligent AI-ML desmoking/dehazing algorithms into firefighting operations represents a significant advancement in enhancing the safety and efficiency of rescue missions during indoor fire hazards. This abstract encapsulates the essence of a groundbreaking mini project aimed at developing a state-of-the-art technological solution to address the challenges faced by firefighters in smoke-filled and hazy environments. The core objective of this project is to leverage artificial intelligence and machine learning techniques to create an advanced algorithm capable of effectively removing smoke and haze from visual data captured in real-time. By harnessing the power of image processing and computer vision technologies, this innovative system aims to provide firefighters with clearer, more detailed imagery to improve situational awareness and decision-making in emergency scenarios. Through the seamless integration of desmoking/dehazing capabilities into firefighting equipment or wearable devices, this project seeks to empower first responders with enhanced visibility and operational effectiveness when navigating through hazardous environments. By enabling rapid access to clearer visual information, this AI-ML algorithm has the potential to revolutionize rescue operations by facilitating quicker response times, more precise navigation, and ultimately, saving lives. In conclusion, the development of an intelligent AI-ML desmoking/dehazing algorithm holds immense promise for transforming the landscape of firefighting technology. By combining cutting-edge artificial intelligence with practical applications tailored for real-world firefighting scenarios, this project represents a significant step forward in enhancing the safety, speed, and success rates of rescue missions during indoor fire hazards.

INTRODUCTION

In the realm of firefighting and emergency response, the ability to effectively navigate through smoke-filled and hazy environments is paramount for ensuring the safety of both firefighters and individuals in need of rescue. Recognizing the critical importance of visibility in such challenging conditions, a pioneering mini project has been initiated to develop an intelligent AI-ML desmoking/dehazing algorithm tailored specifically to enhance rescue operations during indoor fire hazards. This innovative endeavor represents a significant leap forward in leveraging cutting-edge technology to support and empower firefighters in their life-saving missions. The primary goal of this project is to harness the power of artificial intelligence, machine learning and computer vision techniques to create a sophisticated algorithm capable of rapidly and accurately removing smoke and haze from visual data captured in real-time. By integrating basic image processing techniques and computer vision technologies, this intelligent system aims to provide firefighters with enhanced visibility and clarity in smoke and haze obscured environments, thereby enabling them to make informed decisions swiftly and effectively during rescue operations. The development of this AI-ML desmoking/dehazing algorithm is driven by a commitment to revolutionize the way firefighting and rescue missions are conducted in indoor fire hazard scenarios. By equipping firefighters with state-of-the-art technological tools that enhance their situational awareness and operational capabilities, this project seeks to optimize response times, improve decision-making processes, and ultimately save lives in emergency situations. Through the seamless integration of desmoking/dehazing functionalities into existing firefighting equipment or wearable devices, this project aims to provide firefighters with a clear advantage when faced with challenging visibility conditions. By enabling real-time enhancement of visual data captured in smoke-filled environments, this AI-ML algorithm has the potential to significantly enhance the safety, efficiency, and effectiveness of rescue missions, thereby mitigating risks and maximizing outcomes during critical operations. In conclusion, the development of an intelligent AI-ML desmoking/dehazing algorithm represents a groundbreaking advancement in the field of firefighting technology. By combining cutting-edge artificial intelligence with practical applications tailored for real-world firefighting scenarios, this project stands poised to redefine the capabilities of rescue operations during indoor fire hazards, setting a new standard for safety, innovation, and effectiveness in emergency response efforts.

AIM & OBJECTIVES OF PROJECT

Aim:

The aim of the project is to develop an intelligent AI-ML desmoking/dehazing algorithm specifically designed to enhance visibility and support firefighters during indoor fire hazards. This cutting-edge technology aims to revolutionize rescue operations by providing advanced desmoking/dehazing capabilities to improve situational awareness and operational efficiency in smoke-filled environments.

Objectives:

- Enhance Visibility: Develop an AI-ML algorithm that can effectively remove smoke and haze from visual data captured in real-time, enhancing visibility for firefighters during rescue operations.
- Improve Decision-Making: Enable firefighters to make informed decisions swiftly and effectively by providing clearer, more detailed imagery of their surroundings in hazardous conditions.
- Optimize Response Times: Integrate desmoking/dehazing functionalities into firefighting equipment or wearable devices to empower first responders with enhanced visibility, leading to quicker response times during emergencies.
- Ensure Safety: Enhance the safety of firefighters by providing access to clearer visual information in smoke-obscured environments, minimizing risks and improving operational effectiveness during rescue missions.
- Facilitate Efficient Rescue Efforts: Support firefighters in navigating through challenging indoor fire hazard scenarios by equipping them with state-of-the-art technological tools that streamline rescue operations and maximize outcomes.

By achieving these objectives, the project aims to significantly enhance the capabilities of firefighters during indoor fire hazards, ultimately contributing to saving lives, reducing property damage, and improving the overall effectiveness of rescue missions.

PROPOSED WORK

Technology used:

- **Front End**

  HTML, CSS, Java Script: HTML, CSS, and JavaScript work together to create web pages: HTML structures content, CSS styles it, and JavaScript adds interactivity and dynamic behavior to enhance user experience.

- **Back End**

  Python (Libraries: Open CV.js): Python, along with its OpenCV library, provides a powerful platform for computer vision tasks, offering a wide range of functions and tools for image & video processing and analysis. OpenCV.js leverages Emscripten to compile OpenCV functions into asm.js or WebAssembly targets, and provides a JavaScript APIs for web application to access them.

- **Tools**:

  1. Figma: Figma is a collaborative web application for user interface design emphasizing real-time collaboration, vector graphics editing, and prototyping tools.
  2. Firebase: Firebase realtime database allows for efficient real-time data retrieval and manipulation through asynchronous listeners and database references.
  3. Github: GitHub is a web-based version control and collaboration platform that enables software developers to store, track changes, and collaborate on projects efficiently through features like repositories, branches, commits, and pull requests.
  4. VSCode: Visual Studio Code is a lightweight yet powerful source code editor that supports various programming languages, offers intelligent code completion, debugging tools, and extensive customization options for efficient development workflows.
  5. Postman: Postman is a popular tool for API testing that allows developers to create and execute HTTP requests and test API responses. Postman makes API testing more efficient and effective with features such as request builders, response visualizations, and test automation.

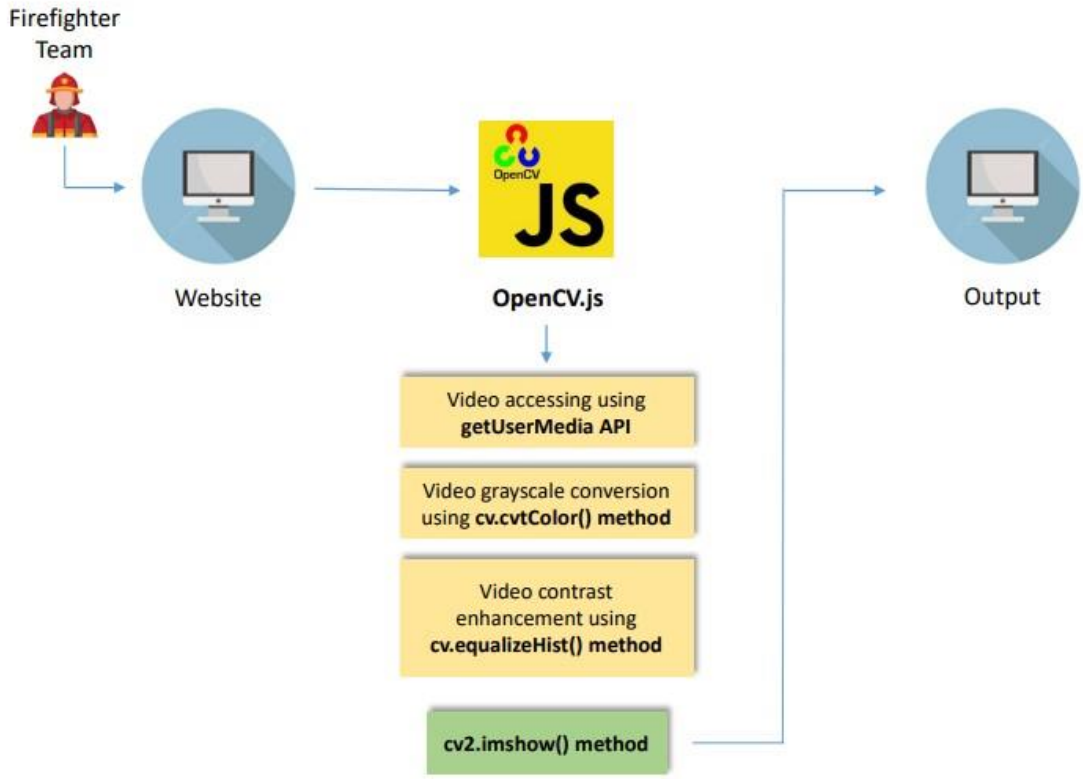

Fig. Working of Project

In this section, let's see the way to solve the given problem:

➢ **Real-Time Video Accessing on Web Page:**

- The code sets up the HTML and JavaScript necessary to capture video from the user's camera and display it on the page.
- It creates a <video> tag with the id cam_input and sets its height and width.
- It also creates a <canvas> tag with the id canvas_original and sets its margin-top.
- It does the same for another <canvas> tag with the id canvas_desmoked.

➢ **JavaScript Functionality**:

- The JavaScript code is contained within the openCvReady() function, which is called when the OpenCV library is loaded.
- Within openCvReady(), it first gets a reference to the <video> tag using document.getElementById("cam_input").
- It then requests access to the user's camera using navigator.mediaDevices.getUserMedia({ video: true, audio: false }).

- If the user grants access, the video stream is set as the source of the <video> tag using video.srcObject = stream; and the video is played using video.play();.
- It creates two Mat objects, src and dst, to hold the input and output video frames, respectively.
- It creates a VideoCapture object, cap, to capture video frames from the <video> tag.
- It creates a Utils object, utils, to handle error messages.
- It sets the frames per second (FPS) to 24.

➢ **OpenCV.js Video Processing and Output Display**:

- It defines a desmoke() function to apply contrast enhancement to the video frames.
- Within desmoke(), it first converts the input frame to grayscale using cv.cvtColor(input, gray, cv.COLOR_RGBA2GRAY, 0);.
- It then applies contrast enhancement to the grayscale frame using cv.equalizeHist(gray, output);.
- It defines a processVideo() function to capture and process video frames.
- Within processVideo(), it first gets the current time using let begin = Date.now();.
- It then captures a video frame using cap.read(src);.
- It applies the desmoke() function to the video frame using desmoke(src, dst);.
- It displays the original video frame using cv.imshow("canvas_original", src);.
- It displays the processed video frame using cv.imshow("canvas_desmoked", dst);.
- It schedules the next frame to be processed using setTimeout(processVideo, delay);, where delay is calculated based on the desired FPS and the time taken to process the current frame.
- It schedules the first frame to be processed using setTimeout(processVideo, 0);.

➢ **Evaluation and Testing**:

- Conducting performance evaluation of OpenCV-based techniques using standard image and video quality metrics.
- Implementing testing softwares like Postman for testing and performance benchmarking.

RESEARCH METHODOLOGY

- **Research Objective**:

The primary objective of this research project is to develop an AI-ML based intelligent desmoking/dehazing algorithm for enhancing image and video quality on a website.

- **Research Design**:

- The research design will be experimental, focusing on the development and implementation of the AI-ML algorithm for desmoking/dehazing.

- The project will involve qualitative analysis to evaluate the performance and effectiveness of the algorithm.

- **Sampling Strategy**:

- The sampling strategy will involve collecting a set of image and video data for testing and validation purposes.

- Various datasets will be used to assess the algorithm's performance under various conditions.

- **Data Collection Methods**:

- Data collection will involve acquiring image and video datasets with varying levels of smoke and haze.

- The datasets will be tested with the OpenCV processing techniques.

- **Evaluation and Testing**:

- Testing will be conducted to assess the technique’s effectiveness in desmoking/dehazing images and videos.

- **Documentation and Reporting**:

- The research findings, methodology, and results will be documented in a comprehensive report.

- The website showcasing the AI-ML based intelligent desmoking/dehazing algorithm will be developed and made accessible for demonstration.

APPLYING ALGORITHM ON DATA

After performing appropriate OpenCV techniques for desmoking/dehazing, and testing it on images, the following results were obtained:

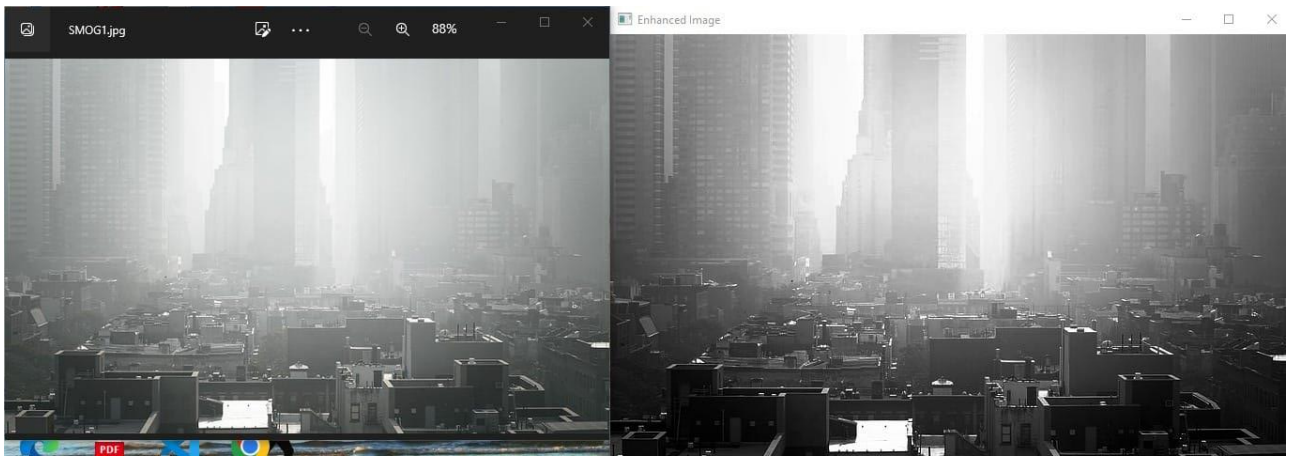

Fig. Desmoking/dehazing on image 1

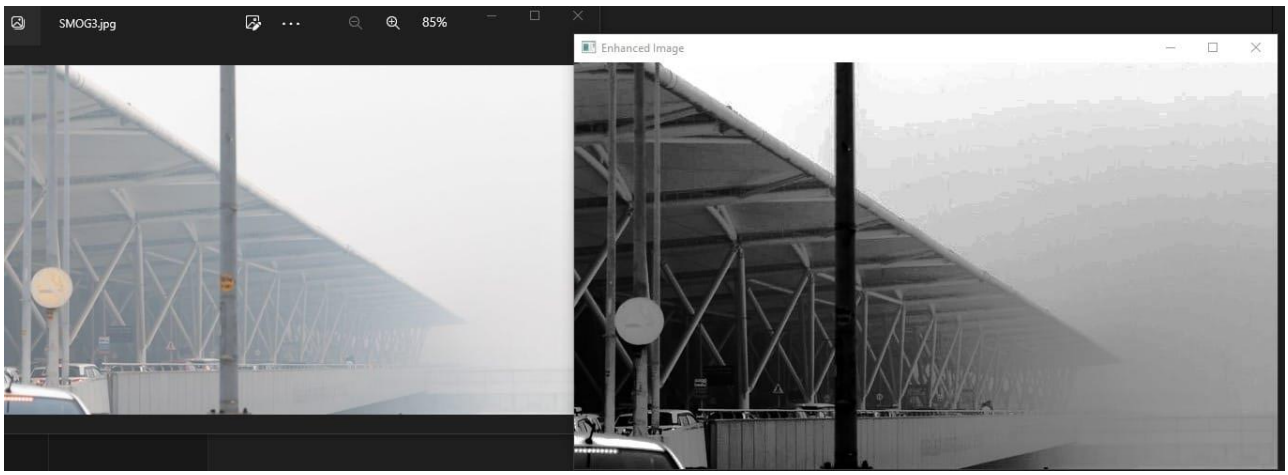

Fig. Desmoking/dehazing on image 2

CONCLUSION

In conclusion, this detailed literature review underscores the significance of intelligent AI-ML desmoking/dehazing algorithms in reshaping rescue operations during indoor fire hazards. By synthesizing research on desmoking techniques, computer vision applications, real-time image processing, and wearable technology for firefighters, this project aims to push the boundaries of technological innovation to enhance visibility, safety, and operational efficiency in firefighting scenarios. The convergence of these diverse research areas sets a solid foundation for developing advanced solutions that empower firefighters with the necessary tools to navigate challenging environments effectively and save lives efficiently.

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