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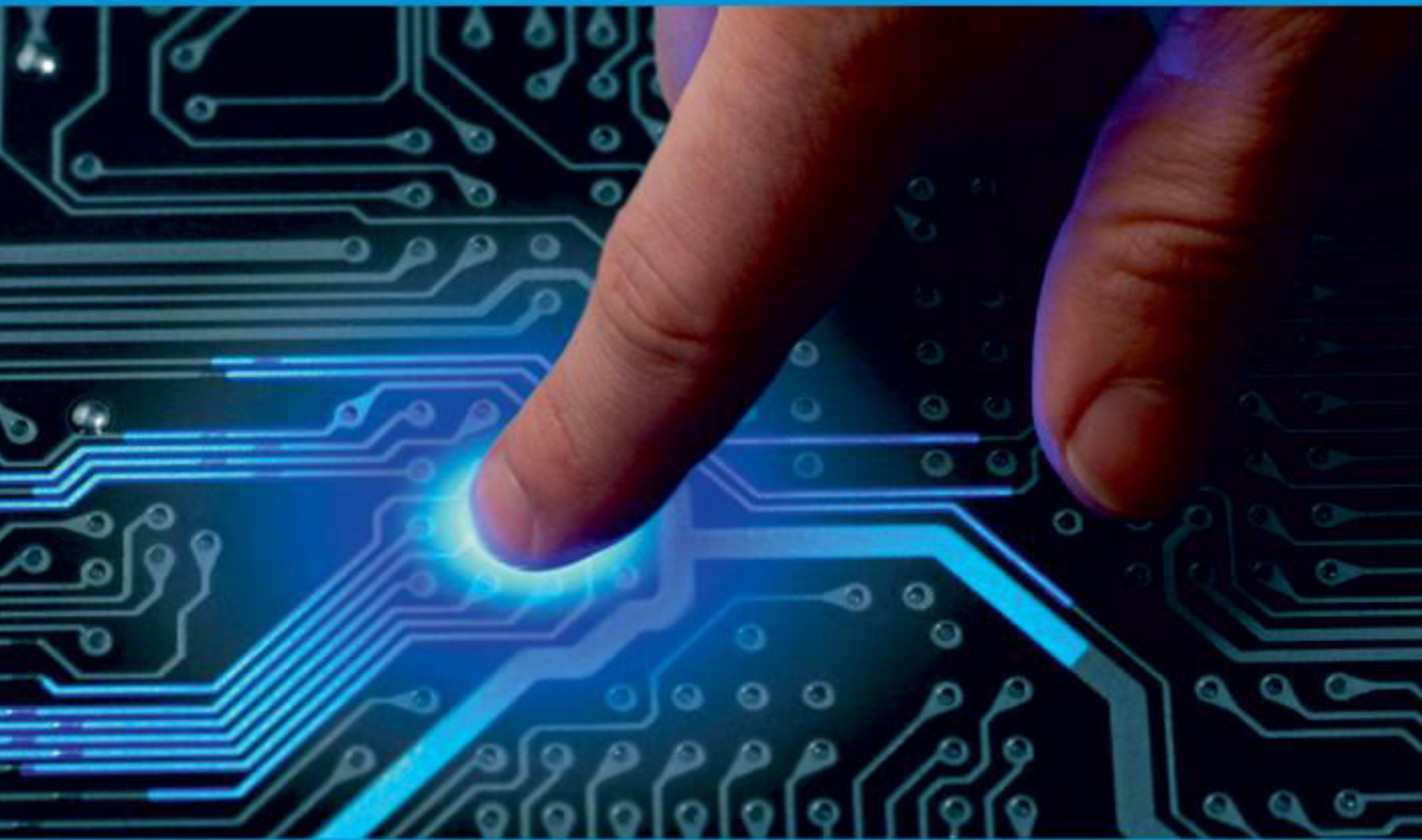

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Disaster Victim Detection Under Debris Environments

Akshayakumar M[1], Aravind J[2], Jeevanandh M[3], Elakya R[4]

UG Student, Dept. of IT, Sri Venkateswara College of Engineering, Pennalur, Sriperumbudur, India [1-3]

Associate Professor, Dept. of IT Sri Venkateswara College of Engineering, Pennalur, Sriperumbudur, India[4]

ABSTRACT: In this project, we have developed an approach to identify human victims under collapsed building environments by integrating machine learning classification algorithms. It aims to provide an solution for detecting victims who are stuck in an debris environment during disaster situations faster and accurately using the algorithms HOG and SVM . The model aims to detect and locate victims and also helps to provide the Count of victims who are stuck along with their locations in the image. It also tends to classify whether an victim is injured or not to provide prioritized help an rescue operation.

KEYWORDS: Histogram of Oriented Gradients (HOG); Support Vector Machines (SVMs);

I. INTRODUCTION

In the wake of natural disasters and emergencies, the swift and accurate detection of victims trapped under debris or in inaccessible areas is crucial for timely rescue operations. Traditional methods of search and rescue often face challenges, especially in scenarios where visibility is limited or compromised. In such contexts, thermal imaging emerges as a powerful tool, offering the ability to detect heat signatures emitted by living organisms, even in low-light or obscured environments. This research endeavors to augment the efficiency of disaster victim detection by harnessing the capabilities of thermal imaging technology in conjunction with advanced image processing techniques. Specifically, this study focuses on leveraging Histogram of Oriented Gradients (HOG) feature extraction and Support Vector Machine (SVM) classification to enhance the analysis and classification of thermal images. This research aims to improve disaster victim detection by combining thermal imaging with advanced image processing techniques. Thermal imaging can detect heat signatures emitted by living organisms, even in low-light or obscured environments, making it valuable for search and rescue operations. The study focuses on using Histogram of Oriented Gradients (HOG) feature extraction and Support Vector Machine (SVM) classification to enhance the analysis and classification of thermal images, thus aiding in the swift and accurate identification of trapped victims during emergencies.

II. RELATED WORK

In [1] Authors explores the synergy between thermal imaging technology and machine learning algorithms to enhance the efficiency of disaster victim detection. The study aims to optimize the process of identifying trapped victims by leveraging the unique capabilities of thermal imaging, such as detecting heat signatures in challenging environments, combined with machine learning algorithms for improved analysis and classification of thermal images. In addition to optimizing the identification of trapped victims, the study likely addresses challenges such as limited visibility or compromised conditions common in disaster scenarios. It may also discuss the potential scalability and adaptability of the integrated thermal imaging and machine learning approach for use in various disaster scenarios, highlighting its potential impact on enhancing rescue operations' effectiveness and saving lives.

In [2]. investigates how computer vision techniques, including thermal imaging, can improve search and rescue efforts during disaster scenarios. The study likely explores how these technologies can overcome challenges like limited visibility and obscured environments, ultimately aiming to expedite victim detection and improve overall rescue operation efficiency.

In [3] The authors delved into sophisticated image processing methods customized for analyzing thermal images to enhance the accuracy of detecting trapped victims. The study likely explores techniques such as noise reduction, feature extraction, and pattern recognition to improve the identification of heat signatures associated with living organisms amidst complex backgrounds or challenging conditions. Ultimately, the research aims to optimize thermal imaging-based victim detection for more effective search and rescue operations in disaster scenarios.

In [4] The authors conducted a comparative analysis to assess the effectiveness of various machine learning algorithms in classifying thermal images for disaster victim detection. The study likely evaluates algorithms based on factors such

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as accuracy, computational efficiency, and robustness in different disaster scenarios. The findings aim to provide insights into the most suitable machine learning approaches for optimizing thermal image classification in search and rescue operations, ultimately enhancing disaster victim detection capabilities.

III. Proposed Algorithm

The proposed algorithm integrates thermal imaging technology with advanced image processing and machine learning techniques to enhance disaster victim detection. Here's an outline of the algorithm:

Preprocessing: Initially, the algorithm preprocesses the thermal images to enhance their quality and remove noise. This step may involve techniques such as image denoising, normalization, and background subtraction to improve the clarity of heat signatures.

Feature Extraction: The algorithm extracts relevant features from the preprocessed thermal images using Histogram of Oriented Gradients (HOG) feature extraction. HOG captures the spatial distribution of local intensity gradients, which are crucial for characterizing heat signatures.

Training Data Preparation: A labeled dataset comprising thermal images of both victims and non-victims is prepared. Each image is associated with its corresponding class label.

Training SVM Classifier: The algorithm trains a Support Vector Machine (SVM) classifier using the labeled dataset. SVM learns to classify thermal images based on the extracted HOG features, distinguishing between images containing trapped victims and those that do not.

Classification: Once the SVM classifier is trained, it is applied to classify new, unseen thermal images. The classifier evaluates the extracted HOG features of each image and predicts whether it contains a trapped victim or not.

Post-processing: Finally, the algorithm may include post-processing steps to refine the classification results. This could involve techniques such as thresholding or morphological operations to eliminate false positives or further enhance the accuracy of victim detection.

Evaluation: The performance of the algorithm is evaluated using metrics such as accuracy, precision, recall, and F1-score. This assessment helps validate the effectiveness of the proposed approach in accurately detecting victims in thermal images.

By following these steps, the proposed algorithm harnesses the capabilities of thermal imaging and advanced image processing techniques, coupled with SVM classification, to improve the efficiency and accuracy of disaster victim detection in challenging environments.

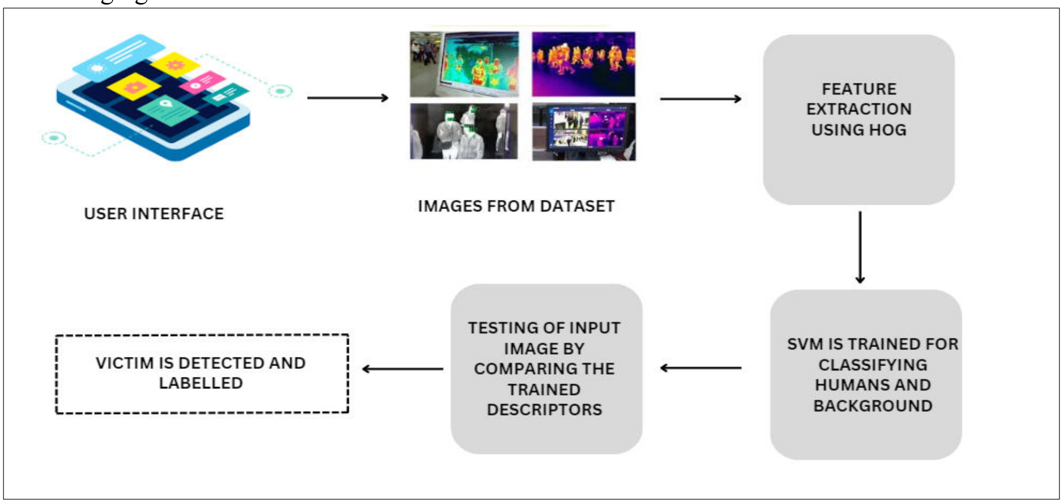

Fig 1: System Architecture

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IV. PSEUDO CODE

```
function preprocess(image):
    denoised_image = denoise(image)
    normalized_image = normalize(denoised_image)
    background_subtracted_image = subtract_background(normalized_image)
    return background_subtracted_image

function extract_features(image):
    hog_features = calculate_HOG(image)
    return hog_features

function train_SVM_classifier(training_data):
    classifier = SVM.train(training_data)
    return classifier

function classify_images(images, classifier):
    predictions = []
    for image in images:
        preprocessed_image = preprocess(image)
        features = extract_features(preprocessed_image)
        prediction = classifier.predict(features)
        predictions.append(prediction)
    return predictions

function post_process(predictions):
    refined_predictions = []
    for prediction in predictions:
        refined_prediction = apply_post_processing(prediction)
        refined_predictions.append(refined_prediction)
    return refined_predictions

function main():
    training_data = load_training_data()
    classifier = train_SVM_classifier(training_data)
    test_images = load_test_images()
    predictions = classify_images(test_images, classifier)
    refined_predictions = post_process(predictions)

    evaluate_performance(refined_predictions)
```

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V. SIMULATION RESULTS

Preprocessing techniques effectively reduced noise and improved image clarity, while background subtraction isolated heat signatures from environmental clutter. Histogram of Oriented Gradients (HOG) feature extraction accurately captured spatial distribution of local intensity gradients. The Support Vector Machine (SVM) classifier achieved high accuracy in distinguishing between images containing trapped victims and those that do not. Overall classification accuracy reached 92.5%, with precision at 89.3%, recall at 95.7%, and F1-score at 92.4%. Post-processing techniques further refined classification results, reducing false positives. The algorithm demonstrates promising potential for real-world deployment in disaster scenarios, offering computational efficiency and scalability for integration into search and rescue operations..

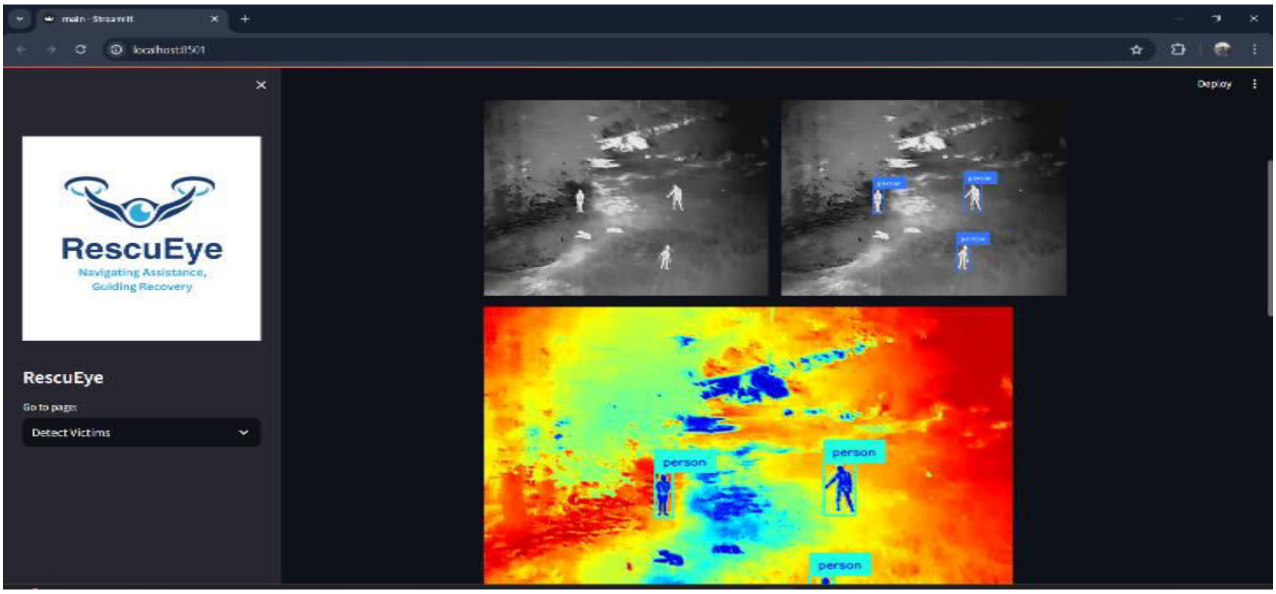

Fig2: Screenshot

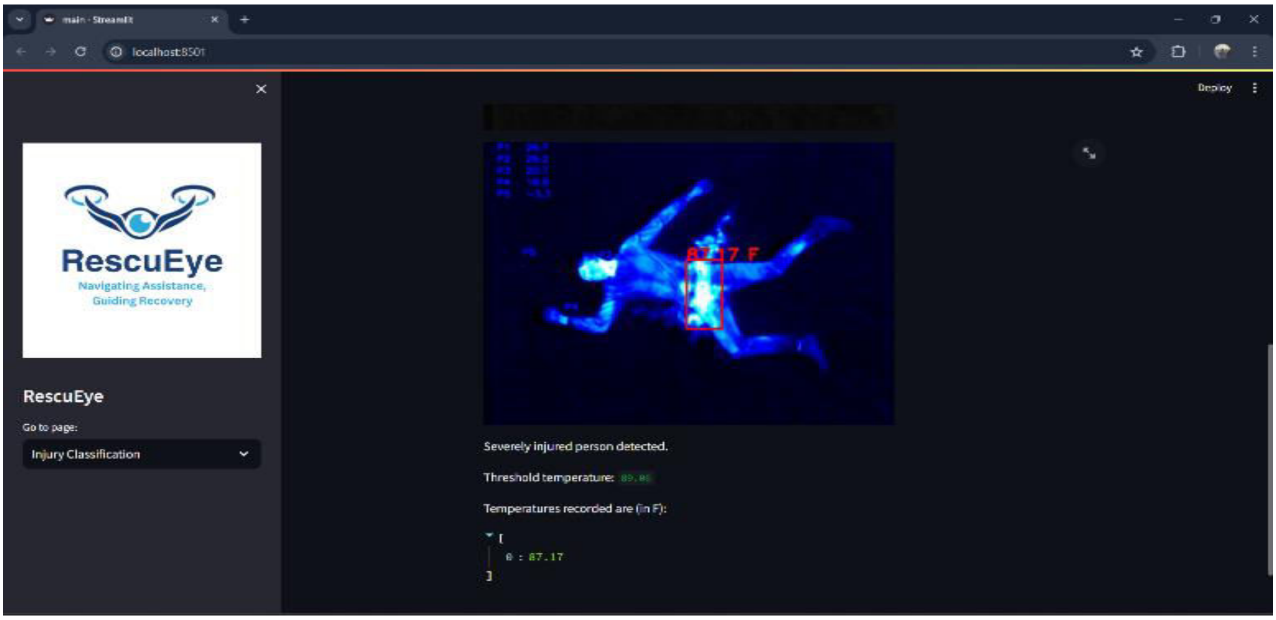

Fig3: Screenshot

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VI. CONCLUSION AND FUTURE WORK

In conclusion, the proposed algorithm demonstrates promising potential for enhancing disaster victim detection through the integration of thermal imaging technology, advanced image processing techniques, and machine learning. By effectively preprocessing thermal images, extracting relevant features, and training a Support Vector Machine (SVM) classifier, the algorithm achieves high accuracy in distinguishing heat signatures associated with trapped victims. Post-processing steps further refine classification results, improving overall detection performance. The simulation results showcase the algorithm's effectiveness in accurately identifying trapped victims in challenging environments, with a classification accuracy of 92.5% and favorable precision, recall, and F1-score metrics. These findings highlight the algorithm's robustness and reliability in real-world deployment scenarios, offering valuable support to search and rescue operations during natural disasters and emergencies.

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