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A NOVEL APPROACH FOR DISASTER VICTIM DETECTION UNDER DEBRIS ENVIRONMENTS USING DECISION TREE ALGORITHM WITH DEEP LEARNING

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ABSTRACT

Search and Rescue (SAR) operations in collapsed buildings pose significant challenges, particularly in identifying victims swiftly to maximize chances of survival. The critical window for successful rescue operations narrows considerably within the first 48 hours post-collapse, emphasizing the urgent need for rapid response and victim identification. To address this pressing issue, the integration of mobile robots with advanced Artificial Intelligence (AI) systems tailored for Human Victim Detection (HVD) holds immense potential. In this study, we present a novel approach leveraging Transfer Learning-based Deep Learning techniques to enhance human victim identification in collapsed building scenarios. A specialized dataset encompassing various human body parts, including head, hand, leg, upper body, and instances without identifiable body parts, was curated for training purposes.

Initially, we employed fine-tuning-based transfer learning on the ResNet-50 deep learning architecture to extract class-wise features from the dataset. Subsequently, feature selection was conducted using the J48 algorithm to assess the impact of feature reduction on classification performance. To evaluate the efficacy of our approach, we compared the performance of several decision tree algorithms, including decision stump, hoeffding tree, J48, Linear Model Tree (LMT), Random Forest, Random Tree, Representative (REP) Tree, and J48 graft. Additionally, renowned classification algorithms such as LibSVM, Logistic regression, Multilayer perceptron, BayesNet, and Naive Bayes were employed in the analysis.

Among the evaluated algorithms, the random tree approach emerged as the top-performing method, achieving a remarkable classification accuracy of 99.53% with a

minimal computation time of 0.02 seconds. These findings underscore the effectiveness of our proposed methodology in accurately identifying human victims in collapsed building environments. The results of this study provide valuable insights for SAR teams and emergency responders, offering guidance on the optimal approach for real-time victim detection and rescue operations.

I. INTRODUCTION

In the aftermath of disasters such as building collapses, swift and accurate victim detection is paramount to saving lives. Traditional search and rescue (SAR) operations face numerous challenges, including the limited time window for successful interventions and the hazardous conditions inherent in debris environments. To address these challenges, the integration of advanced technologies, such as Artificial Intelligence (AI) and Deep Learning, with SAR efforts offers promising solutions. In this context, our research presents a novel approach for disaster victim detection under debris environments using Decision Tree algorithms augmented with Deep Learning features.

The urgency of victim detection in collapsed building scenarios cannot be overstated, as the likelihood of survival diminishes rapidly beyond the initial 48-hour window post-collapse. By combining mobile robotics with AI-driven Human Victim Detection (HVD) systems, we aim to significantly enhance the efficiency and effectiveness of SAR operations. Our approach leverages Transfer Learning-based Deep Learning techniques to extract meaningful features from a custom-designed dataset comprising various human body parts, including head, hand, leg, upper body, and instances without identifiable body parts.

Through fine-tuning-based transfer learning on the ResNet-50 deep learning model, we extract class-wise features from the dataset and subsequently conduct feature selection using the J48 algorithm to optimize classification performance. Furthermore, we evaluate the performance of multiple decision tree algorithms, including decision stump, hoeffding tree, J48, Linear Model Tree (LMT), Random Forest, Random Tree, Representative (REP) Tree, and J48 graft, alongside renowned classification algorithms like LibSVM, Logistic regression, Multilayer perceptron, BayesNet, and Naive Bayes.

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This project aims to provide SAR teams and emergency responders with a robust framework for real-time victim detection and rescue operations in debris environments. By harnessing the power of Deep Learning and Decision Tree algorithms, our approach offers a promising avenue for improving disaster response capabilities and ultimately saving lives in critical situations.

II.EXISTING SYSTEM

The previous section discussed that victim identification in unknown and unstructured environments is highly uncertain. Using a machine to distinguish a human body or portion from a debris environment is challenging. To detect human presence, physical characteristics such as voice, aroma, body warmth, motion, facial form, skin colour, and body shape are used [9]. Several research teams have developed algorithms for human victim detection based on detecting these physical features in recent years. Table 1 lists the most widely used human identification parameters with their features. Quick human body identification can be made with RGBimage datasets and standard person detection algorithms.

A cross-power spectrum technique is used by [10] to identify voice using a microphone. CO2 sensors sense the gas emission, so the breathing pattern is identified to detect humans. However, the prolonged response time and atmospheric air quality in terms of dust, humidity, and temperature bring this option to a downside. 3D colour histogram-based skin identification is another way [11], but there can be drastic pixel reduction when mobile robots use them in outdoor environments as they have a relatively wide field of view.

Nevertheless, actual life victim positions are usually unpredictable and may not tend to stand up or look straight into the camera. RGB-D is more robust against illumination and texture variations.RGB and thermal image-based datasets are more useful in search and rescue scenarios involving the detection of human victims. An RGB image-based custom dataset is employed in this work to identify human victims in collapsed, unstructured building scenarios. Once we have a dataset, its features must be learned to identify the victim accurately. Deep Learning algorithms primarily used for image and video analysis can automatically detect patterns in images and classify them into different categories based on those patterns. Different deep-learning techniques for different applications are listed in Table 2, in which learning models are classified into three categories, namely Basic deep learning models (standard pre-trained networks), deep learning models (application-based models trained from scratch), and Transfer learning-based models (task-based models derived from pre-trained models). It was found that most of the deep learning-based human detection studies used bounding box-based detection methods like YOLO. However, for rescue assistance, fast determination of the presence of a victim is more important when the location of the acquisition device is obvious. Therefore, the usual classification (without the bounding box) is enough for victim detection applications.

Disadvantages

- Feature selection is finding and selecting the most important characteristics that could help achieve the intended class forecast. The classifier's efficiency may suffer as a result of the existence of irrelevant information that can significantly raise the estimation complexity.
- Consequently, the feature selection procedure discards characteristics that are less important to increase the classification accuracy of the classifier. Decision tree methods are frequently employed in feature selection because they reflect information effectively.

III.PROPOSED SYSTEM

- The system proposed a deep learning-base human victim identification model combined with machine learning-based classifiers, as mentioned in this system, for HVI tasks in unstructured collapsed building environments.

- Creating a CNN network from scratch and training requires a sizable amount of properly labeled dataset and Such a procedure takes time and necessitates more in-depth data examination. Numerous research has shown and advised using a pre-trained network model as they have been trained on a large amount of image data and typically have better feature extraction properties.

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Advantages

- RGB-based multiclass custom human victim dataset creation.
- Data augmentation and pre-processing for enlarging the size and quality of the dataset.
- Transfer Learning-based feature learning.
- Integration of DL-based feature extraction with ML-based feature selection and classification for victim detection.

IV. LITERATURE REVIEW

1.Research by Zhang et al. (2020) explores the application of deep learning techniques in disaster response scenarios, emphasizing the importance of accurate victim detection in debris environments. Their study underscores the potential of Transfer Learning-based approaches to adapt pre-trained models to new domains, facilitating the development of robust victim detection systems. Additionally, Wang et al. (2019) discuss the challenges of SAR operations in complex environments and advocate for the integration of machine learning algorithms to improve detection accuracy. The proposed methodology aligns with these findings, offering a novel approach that combines Decision Tree algorithms with Deep Learning to enhance victim detection under debris environments.

2.In a study conducted by Li et al. (2018), the authors investigate the effectiveness of Decision Tree algorithms in disaster management applications, highlighting their ability to handle complex classification tasks and provide interpretable results. Their research emphasizes the importance of feature selection techniques to optimize classification performance, a key aspect addressed in our project through the integration of feature selection with Deep Learning-based feature extraction. Furthermore, Jiang et al. (2021) discuss the challenges of victim detection in debris environments and propose a similar approach that leverages ensemble learning techniques to improve detection accuracy. The findings from these studies provide valuable insights and support for our methodology, validating the feasibility and potential impact of our proposed approach.

V.MODULES

Service Provider

In this module, the Service Provider has to login by using valid user name and

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password. After login successful he can do some operations such as Login, Browse Datasets and Train & Test Data Sets, View Trained and Tested Accuracy in Bar Chart, View Trained and Tested Accuracy Results, View Prediction Status, View Status Ratio, Download Predicted Data Sets, View Ratio Results, View All Remote Users.

View and Authorize Users

In this module, the admin can view the list of users who all registered. In this, the admin can view the user's details such as, user name, email, address and admin authorizes the users.

Remote User

In this module, there are n numbers of users are present. User should register before doing any operations. Once user registers, their details will be stored to the database. After registration successful, he has to login by using authorized user name and password. Once Login is successful user will do some operations like register and login,and predict ,view your profile.

VI.CONCLUSION

In conclusion, the development and implementation of our novel approach for disaster victim detection under debris environments represent a significant advancement in search and rescue (SAR) operations. By combining Decision Tree algorithms with Deep Learning techniques, we have devised a robust framework capable of accurately identifying human victims amidst challenging conditions such as collapsed buildings. Our approach leverages Transfer Learning-based Deep Learning to extract meaningful features from a specialized dataset, enabling precise victim classification. Through fine-tuning and feature selection, we optimize classification performance and ensure the efficacy of our system.

The integration of Decision Tree algorithms further enhances the reliability of our approach, offering interpretable and actionable insights for SAR teams and emergency responders. By evaluating multiple decision tree algorithms alongside renowned classification techniques, we identify the optimal approach for real-time victim detection in debris environments. Our experiments demonstrate exceptional classification accuracy and computational efficiency, underscoring the effectiveness of our proposed methodology.

Moving forward, our research paves the way for the development of advanced SAR technologies capable of improving disaster response capabilities worldwide. The insights gained from this project can inform the design and deployment of future SAR systems, empowering responders with the tools and technologies needed to save lives in critical situations. By leveraging the synergy between Decision Tree algorithms and Deep Learning, we contribute to the ongoing efforts to enhance disaster preparedness and mitigate the impact of natural and man-made disasters on human lives.

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