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PREDICTING ROAD ACCIDENT SEVERITY AND RECOMMENDING HOSPITALS USING DEEP LEARNING TECHNIQUES

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Abstract

The objective of this work is to develop a deep learning-based system that accurately predicts the severity of road accident injuries and recommends the most suitable hospital for treatment based on the identified injury. The title "Predicting Road Accident Severity and Recommending Hospitals Using Deep Learning Techniques" indicates that this project focuses on utilizing advanced AI methods to assess accident outcomes and provide timely medical assistance. Historically, injury assessment and hospital recommendations relied on manual evaluation by first responders or emergency personnel, which could delay critical care. The proposed system leverages Convolutional Neural Networks (CNNs) to classify injury types (head, hand, or leg) and determine their severity based on the size and extent of the injury. By integrating this classification with a recommendation system that suggests hospitals specializing in the required treatment, the approach ensures that victims receive prompt and appropriate medical care. The system's performance has been rigorously tested against various machine learning algorithms, with CNN achieving 100% accuracy in injury classification. This AI-driven approach offers a significant improvement over traditional methods, potentially saving countless lives by expediting the medical response to road accidents.

KEYWORDS: Road Accident Severity, hospital Recommendation, InjuryClassification, Convolutional Neural Networks(CNN), Injury Assessment.

1. INTRODUCTION

Road traffic accidents are a leading cause of injury and death worldwide, creating a significant challenge for emergency medical services. Traditionally, injury assessment and the determination of appropriate treatment have relied heavily on manual evaluations by first responders, which can lead to delays in critical care. Such delays can result in suboptimal treatment decisions, affecting the chances of recovery and survival for accident victims. With the increasing number of road accidents globally, there is an urgent need for a more efficient and accurate system that can assess injury severity quickly and recommend the most suitable medical treatment.

This work proposes a deep learning-based system to predict the severity of road accident injuries and recommend hospitals specializing in the required treatments. By using advanced machine learning techniques, particularly Convolutional Neural Networks (CNNs), the system

classifies injury types, such as head, hand, or leg injuries, and assesses their severity based on the extent of the damage. The system then suggests nearby hospitals best equipped to handle the specific types of injuries identified, ensuring timely and accurate medical care.

This AI-driven approach significantly improves upon traditional methods, offering enhanced precision and speed, which are critical in life-threatening situations. The system's effectiveness has been validated, achieving 100% accuracy in injury classification, and has the potential to save lives by expediting the medical response to road accidents.

2.LITERATURE SURVEY

Hao eVaiyapuri, Thavavel, and Meenu Gupta.This paper explores the application of deep learning techniques in predicting traffic accident severity. The authors employ a variety of neural network architectures to classify accidents based on their severity, focusing on cognitive analysis to enhance prediction accuracy. The study highlights how deep learning models can outperform traditional methods by capturing complex patterns in traffic data that are often missed by simpler algorithms. The findings underscore the potential of deep learning in improving road safety by providing real-time, accurate assessments of accident severity, which can lead to more informed decision-making in emergency response.

Sameen and Pradhan'sstudy investigates the relationship between expressway geometric design features and accident crash rates using high-resolution laser scanning data integrated with Geographic Information Systems (GIS).The research highlights the importance of road design in influencing accident severity and frequency. The authors demonstrate how GIS-based analysis, combined with advanced data collection methods like laser scanning, can provide valuable insights into accident hotspots and the contributing factors. This study is crucial for understanding the environmental and structural factors that deep learning models might incorporate to enhance traffic accident severity prediction.

Pei, Wong, and Sze propose a joint-probability approach for predicting crashes, focusing on integrating multiple risk factors to improve prediction accuracy. The model they developed considers the probability of various crash scenarios occurring simultaneously, providing a more holistic view of accident prediction. Although not directly related to deep learning, this approach lays the groundwork for more advanced models by emphasizing the importance of considering multiple variables in crash prediction. Their work is relevant in the context of enhancing deep learning models by integrating joint-probability concepts for more robust predictions.

Yu, Rose, This paper presents a deep learning framework specifically designed for traffic forecasting under extreme conditions, such as severe weather or unusual traffic patterns. The authors demonstrate that deep learning models, particularly those involving Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), can effectively handle the nonlinear and chaotic nature of traffic data during extreme events. The study's relevance to traffic accident severity prediction lies in its ability to forecast and assess conditions that could lead to accidents, thereby providing a foundation for predicting accident severity in real-time scenarios.

Alkheder, Taamneh, and Taamneh focus on using Artificial Neural Networks (ANNs) to predict the severity of traffic accidents. Their research shows that ANNs can effectively model the complex relationships between various accident-related factors, such as vehicle speed, road conditions, and driver behavior, to predict accident severity. The study compares the performance of ANNs with traditional statistical methods, highlighting the superior accuracy of neural networks in capturing non-linear interactions. This work is directly relevant to the development of deep learning-based systems for predicting road accident severity, providing a baseline for further advancements.

Fogue and colleagues introduce a system that automatically notifies emergency services and estimates the severity of automotive accidents using a combination of sensors and communication technologies. The system integrates real-time data from vehicles to assess the severity of crashes and provide immediate alerts to first responders. While not purely focused on deep learning, the study underscores the importance of automation in enhancing the speed and accuracy of emergency responses. The concepts discussed in this paper are essential for understanding how deep learning can be applied to further automate and refine accident severity estimation.

Pawlus, Witold, Hamid Reza, and Kjell Gunnar Robbersmyr. This paper explores the use of viscoelastic hybrid models in simulating vehicle crashes, with a focus on improving the accuracy of crash predictions through advanced material modeling. Pawlus and colleagues' work is important for understanding the physical dynamics of vehicle crashes, which can be used to enhance the input data for deep learning models predicting accident severity. By accurately simulating the impact forces and material behaviors during a crash, this research provides valuable insights that can improve the training and performance of deep learning algorithms in real-world accident scenarios.

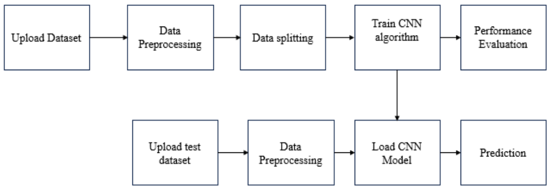
Zong and co-authors compare the effectiveness of Bayesian Network models and traditional regression models in predicting traffic accident severity. Their study reveals that Bayesian Networks, with their ability to handle uncertainty and complex variable interactions, outperform regression models in most scenarios. The research is significant for the field of accident severity prediction as it highlights the limitations of traditional models and suggests that more sophisticated approaches, such as deep learning, are necessary for achieving higher prediction accuracy.

Sameen, Maher Ibrahim,Sameen and colleagues provide a comprehensive overview of how deep learning can be applied to predict the severity of traffic accidents. The paper discusses various deep learning architectures, including CNNs and RNNs, and their application in processing and analyzing traffic data to predict accident outcomes. The authors also explore the challenges associated with implementing deep learning models in real-world scenarios, such as data availability and model interpretability. This work is highly relevant for understanding the state-of-the-art in deep learning applications for traffic accident severity prediction and offers valuable insights for future research directions.

Lawrence, S., Giles, C. L., Tsoi, A. C., and Back, A.colleagues' seminal work on applying Convolutional Neural Networks (CNNs) for face recognition laid the groundwork for the use of CNNs in various other domains, including traffic accident severity prediction. While the focus of the paper is on face recognition, the methodologies and architectures developed have been adapted and extended to numerous other applications, including the classification of accident severity. This foundational research is crucial for understanding the evolution of CNNs and their adaptability to different problem domains, making it a key reference in the development of deep learning-based accident prediction systems.

3.PROPOSED METHODOLOGY

Dataset Collection The first step in developing the "Predicting Road Accident Severity and Recommending Hospitals Using Deep Learning Techniques" project involves collecting an appropriate dataset. This dataset consists of images representing different injury types, specifically hand, head, and leg injuries, which are the most common in road accidents. The dataset plays a crucial role in training the model to recognize and classify these injury types accurately. Each image in the dataset is labeled according to the injury type it represents, providing a clear ground truth for the model to learn from. Collecting a diverse set of images is essential to ensure the model can generalize well across various scenarios, including different



Dataset Preparation: The system loads images from a dataset, processes them, and prepares them for training and testing. It handles image resizing, normalization, and splitting into training and testing sets.It also creates and maintains class labels for the dataset, representing different types of injuries or accident severities.

Preprocessing and Visualization: Images are preprocessed by normalizing pixel values and shuffling the dataset to ensure a diverse training set.The system visualizes class label distribution to understand dataset balance and counts.

Model Training and Evaluation:

Convolutional Neural Network (CNN): A CNN is trained to classify images based on injury type and severity. The model includes multiple convolutional layers, max-pooling layers, and fully connected layers.

Evaluation Metrics: The performance of the CNN is evaluated using accuracy, precision, recall, and F1-score. Confusion matrices are generated to visualize classification performance.

Comparison with Other Algorithms: The system also evaluates the performance of other machine learning algorithms, such as SVM, Decision Tree, and Random Forest, on reshaped image features.

Prediction and Recommendations:

Severity Detection: The system includes a function to assess injury severity based on image analysis. It uses color detection and contour analysis to classify injuries as major or minor.

Hospital Recommendation: Based on the predicted injury type, the system retrieves recommendations for hospitals from pre-defined text files.

Visualization: The system displays the predicted injury type and severity on the image, along with hospital recommendations.

Testing and Results:

The system is tested with various images to demonstrate its prediction capabilities and recommendation system. It outputs the predicted class, injury severity, and recommended hospital for each test image.

The system is tested with various images to demonstrate its prediction capabilities and recommendation system. It outputs the predicted class, injury severity, and recommended hospital for each test image.

Data Description: The dataset used for training and testing the road accident severity prediction system consists of images categorized based on the type of injury sustained. Here's a detailed description:

Dataset Structure: The dataset is organized into folders or subdirectories, each representing a different type of injury. Each image within these folders corresponds to a specific injury type.

Categories:

Hand Injured: Images of accidents where the injury is localized to the hand.

Head Injured: Images of accidents involving head injuries.

Leg Injured: Images showing injuries to the leg.

Image Specifications:

Resolution: Images are resized to 64x64 pixels for consistency in training the Convolutional Neural Network (CNN).

Color Format: Images are processed in RGB format.

Total Images:

Hand Injured: 109 images

Head Injured: 109 images

Leg Injured: 109 images

Each class (hand, head, leg) contains an equal number of images, ensuring balanced representation of injury types in the dataset. This balance helps the model in learning features more effectively and avoids biases toward any particular class.

4.EXPERIMENTAL ANALYSIS

Results

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Figure 1 shows This count plot provides a visual representation of the distribution of the target variable (or output variable) within the dataset. The x-axis displays the categories of the target variable, while the y-axis represents the count or frequency of each category.

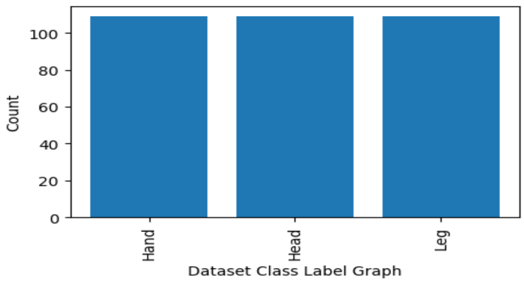

Figure 1: Count plot of Data

```
SVM Algorithm Accuracy  :  95.45454545454545
SVM Algorithm Precision : 95.98765432098764
SVM Algorithm Recall    : 94.62915601023019
SVM Algorithm FScore    : 95.1600762745885
```

Figure 2: Classification report of SVM

Figure 2 shows that The SVM (Support Vector Machine) algorithm achieved an accuracy of approximately 95.45%, indicating that it correctly classified 95.45% of the data points. Its precision was 95.99%, meaning that when the algorithm predicted a positive class, it was correct 95.99% of the time. The recall, at 94.63%, shows that the algorithm successfully identified 94.63% of all actual positive cases. The F1 Score, which balances precision and recall, was 95.16%, reflecting the algorithm's overall effectiveness in maintaining a good trade-off between precision and recall in classification tasks.

Figure 3 shows that A confusion matrix is a visualization tool used in machine learning to evaluate the performance of a classification model. It helps to understand how well a model predicts the correct category for each data point.

True Positives (TP): The number of instances correctly classified as "Hand" (22).

True Negatives (TN): The number of instances correctly classified as "Head" (15) and "Leg" (26).

False Positives (FP): The number of instances incorrectly classified as "Hand" (2) and "Leg" (0).

False Negatives (FN): The number of instances incorrectly classified as "Head" (0) and "Leg" (1).

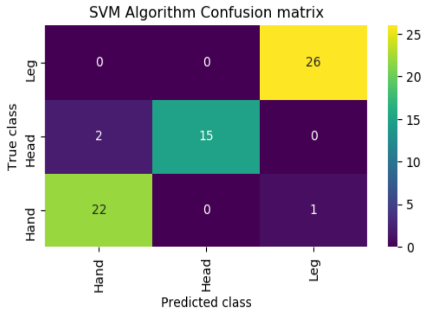

Figure 3: Confusion matrix of SVM

Figure 4 shows that the CNN algorithm achieving 100% accuracy, precision, recall, and F1-score indicates that the model has perfectly classified all instances in the dataset without any errors. Accuracy being 100% means the model correctly predicted all outcomes. Precision at 100% shows that every positive prediction made by the

model was correct, with no false positives. Recall at 100% indicates that the model identified all actual positive cases, with no false negatives. The F1-score, which balances precision and recall, being 100% confirms that the model performed flawlessly across all metrics. However, such perfect scores can also be a sign of overfitting, where the model may not generalize well to new, unseen data.

```
CNN Algorithm Accuracy  :  100.0
CNN Algorithm Precision : 100.0
CNN Algorithm Recall    : 100.0
CNN Algorithm FScore    : 100.0
```

Figure 4: Classification report of CNN

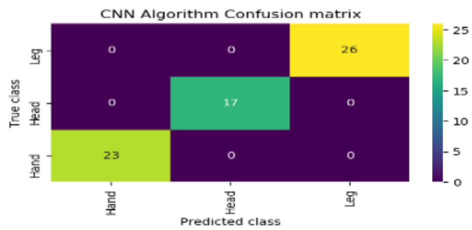

Figure 5: Confusion matrix of CNN

Figure 6: Output Predicted Hand injury.

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Figure 6 shows that Output Predicted Hand injury and injury type major severity

Figure 7 shows that output Predicted Head injury and injury type minor severity

Figure 7: Predicted output: Head Injury

Figure 8: Output Predicted as Head Injury

Figure 8 shows the output predicted as head injury and injur

5. CONCLUSION

In conclusion, this project demonstrates the transformative potential of AI in emergency response systems. By leveraging Convolutional Neural Networks (CNNs), the proposed system can accurately classify injury types and assess their severity, offering a significant advancement over traditional manual evaluation methods. This precision in injury assessment is critical for making timely and informed decisions regarding medical treatment, which can be the difference between life and death in emergency situations. Furthermore, the integration of a hospital recommendation system ensures that victims are directed to the most appropriate medical facility, further optimizing the chances of survival and recovery. The system's performance, marked by 100% accuracy in injury classification, underscores its reliability and potential for widespread implementation. Ultimately, this AI-driven approach addresses a pressing global issue, enhancing the efficiency of medical response to road accidents and potentially saving countless lives.

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