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. Traditional systems lacked the precision and speed needed to accurately determine injury severity, often leading to suboptimal treatment decisions. The problem statement highlights the challenge of timely and accurate injury assessment in the absence of machine learning models, which often resulted in preventable fatalities due to delayed or incorrect treatment. The research motivation stems from the increasing number of road accidents worldwide and the urgent need for a system that can provide immediate and accurate injury assessments, thereby improving survival rates. 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 : Convolutional Neural Networks, Deep learning, AI-driven approach

1. INTRODUCTION

Road accidents have been a persistent and escalating global issue, claiming millions of lives each year and leaving countless others with severe injuries. According to the World Health Organization (WHO), approximately 1.35 million people die annually due to road traffic accidents, making it one of the leading causes of death worldwide. The Global Status Report on Road Safety 2018 highlights that over 50 million people suffer non-fatal injuries each year, often resulting in long-term disabilities. This alarming increase in road accidents and associated injuries underscores the need for more efficient systems to manage emergency responses and medical care. Over the past decade, advancements in deep learning have opened new avenues for enhancing the speed and accuracy of injury assessments following road accidents.Recent statistics indicate that traditional methods of assessing injury severity and recommending hospitals are often insufficient due to their reliance on manual evaluation by first responders. These methods are prone to errors and delays, which can exacerbate the victim's condition. For instance, the U.S. National Highway Traffic Safety Administration (NHTSA) reported that in 2020, a significant percentage of fatalities in road accidents occurred due to delays in receiving appropriate medical care. In response to this, the integration of AI-based systems, particularly Convolutional Neural

Networks (CNNs), has shown promise in predicting injury severity with remarkable precision. The development of such systems aims to bridge the gap between accident occurrence and the provision of timely medical assistance, potentially reducing fatalities and improving recovery outcomes for road accident victims.Enhancing elderly care has become a critical issue as the global population ages. The United Nations projects that by 2050, the number of people aged 60 and above will reach 2.1 billion, nearly doubling from 1 billion in 2020. This demographic shift presents significant challenges in providing adequate care, particularly in emergency situations such as road accidents. Elderly individuals are more vulnerable to severe injuries due to frailty and pre-existing health conditions, making timely and accurate medical intervention even more critical. Unfortunately, current systems often fail to meet the unique needs of the elderly, resulting in suboptimal care and increased mortality rates.Manual approaches to injury assessment and hospital recommendations following road accidents are fraught with challenges that often lead to suboptimal outcomes. First responders and emergency personnel typically rely on visual inspections and their experience to gauge the severity of injuries, a process that is not only subjective but also prone to errors. This can result in either underestimating or overestimating the severity of the injury, leading to delays in treatment or inappropriate care decisions. In many cases, the lack of immediate access to detailed patient information, such as medical history or allergies, further complicates the decision-making process, increasing the risk of adverse outcomes.The need for automation in this context is driven by the limitations of manual approaches, which cannot consistently deliver the speed and accuracy required in emergency situations. Automation, through the use of AI and deep learning, addresses these issues by providing a standardized, objective, and rapid assessment of injury severity. This not only reduces the likelihood of human error but also ensures that patients receive the most appropriate care as quickly as possible. By automating the process of injury assessment and hospital recommendation, healthcare systems can improve patient outcomes, reduce the burden on emergency personnel, and ultimately save lives.

2. LITERATURE SURVEY

Vaiyapuri, Thavavel, and Meenu Gupta.[1] 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's [2] study 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 [3] 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, et al [4] 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 [5] 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 [6] 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. [7] 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 [8] 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, et al. [9] 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.

3. PROPOSED SYSTEM

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 lighting conditions, skin tones, and injury severities.

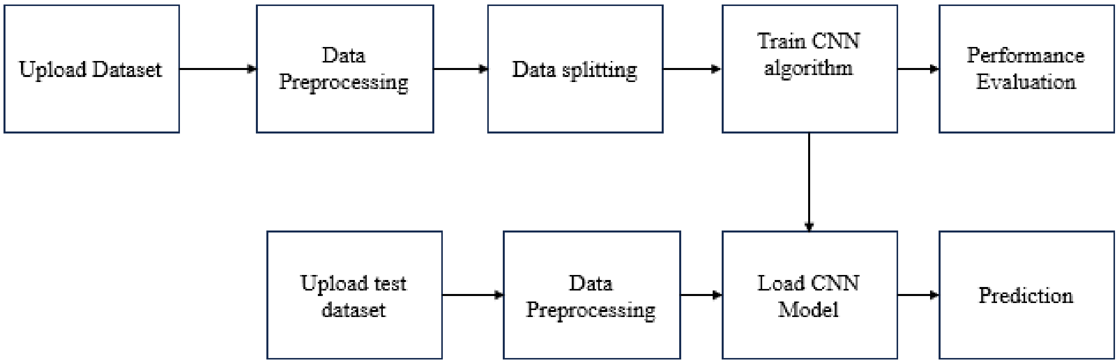

Figure 1: Block Diagram

After gathering the dataset, the next step is preprocessing the data to prepare it for training. Preprocessing involves several tasks, but one of the most critical is handling missing or null values. Null values can occur due to incomplete or corrupted image files, and they can adversely affect the performance of the model if not addressed properly. In this step, any images that contain null values or cannot be processed are removed from the dataset. Additionally, the images are resized to a uniform dimension (e.g., 64x64 pixels) to ensure consistency during model training. This step also involves normalizing the pixel values of the images, typically by scaling them between 0 and 1, which helps the model learn more effectively.Once the dataset has been preprocessed, the next step is to encode the class labels. Label encoding is a method of converting categorical labels (in this case, injury types) into a numerical format that can be processed by the machine learning algorithms. For example, if the injury types are "hand," "head," and "leg," they might be encoded as 0, 1, and 2, respectively. This numerical representation allows the model to differentiate between the different classes during training. Label encoding is a simple yet essential step, as it ensures that the model can interpret the class labels correctly and make accurate predictions.

4. RESULTS AND DISCUSSION

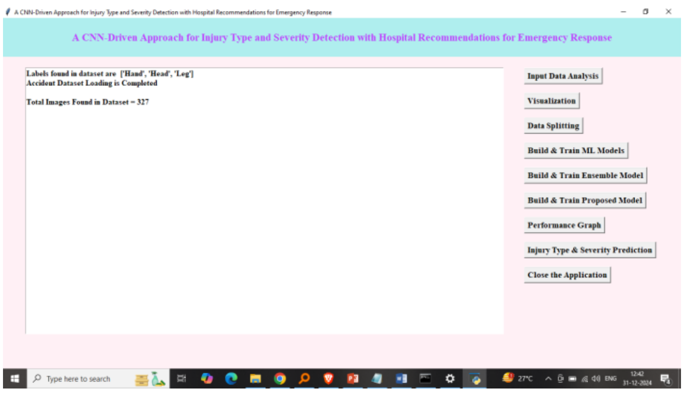

Figure 2: GUI

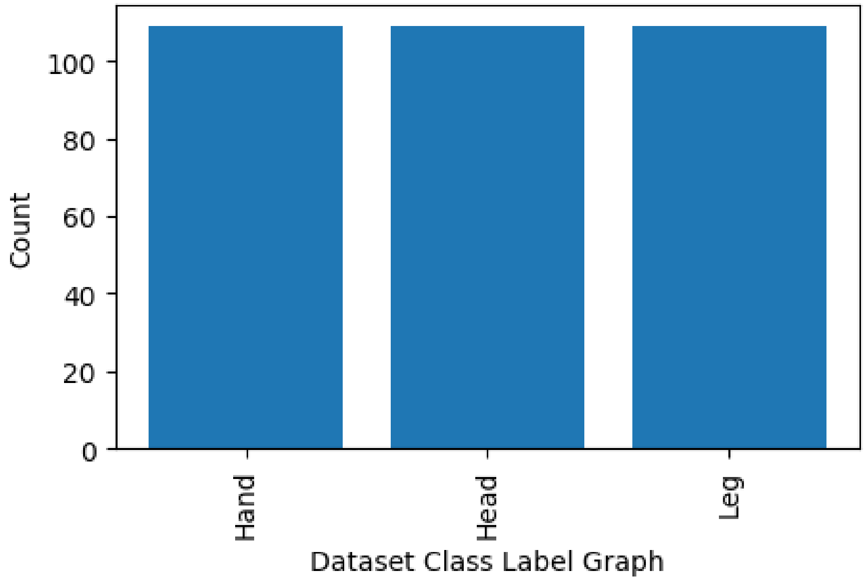

Figure 3: Count plot of the output class

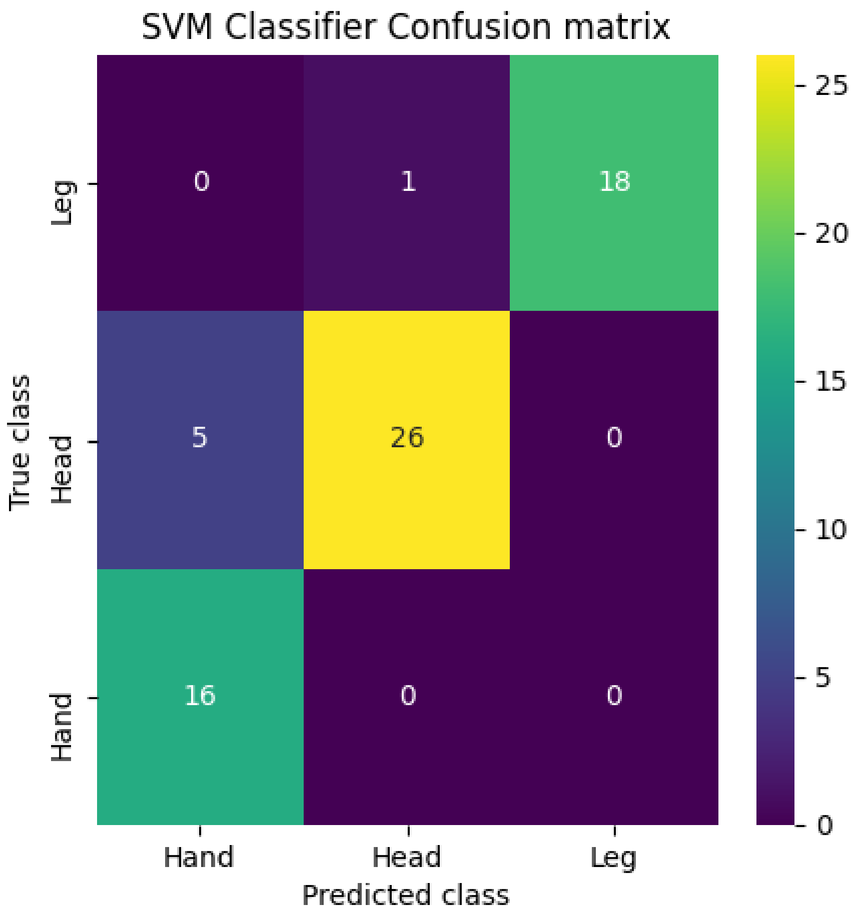

Figure 4: Confusion matrix of the SVM Classifier

Figure 4 shows that confusion matrix of the SVM classifier and figure 5 is the confusion matrix of the Decision tree which have more False values

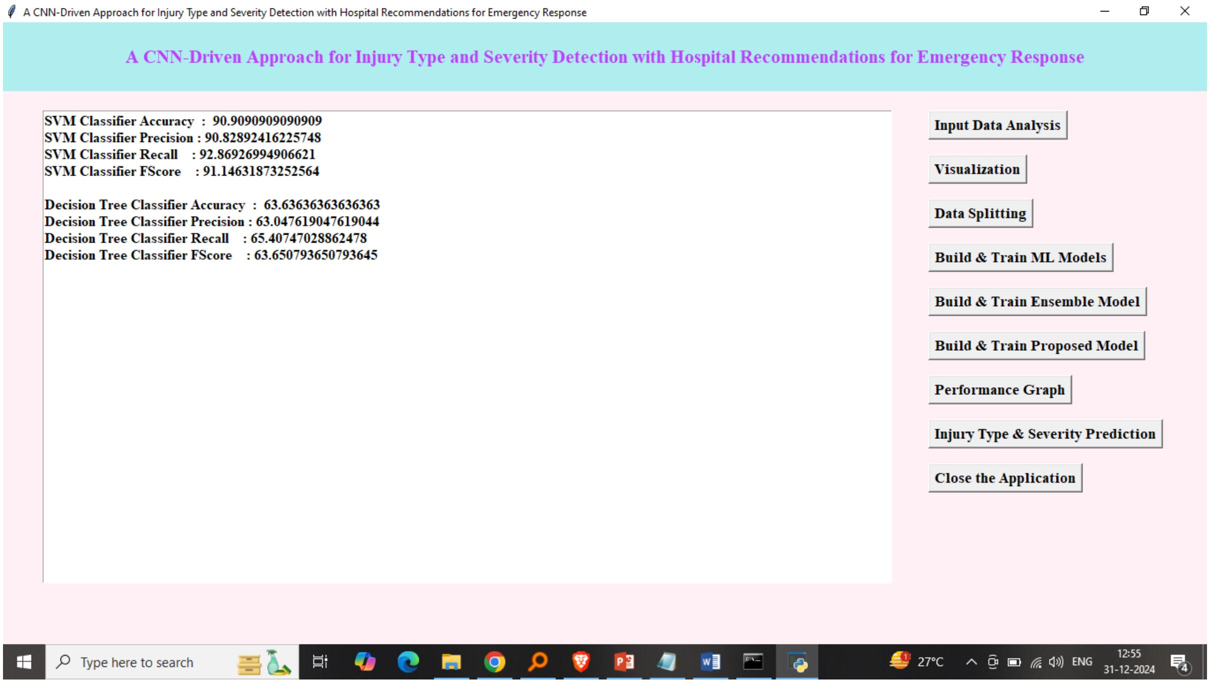

Figure 5: Evaluation of the SVM Classifier

Figure 5 shows that The SVM Classifier demonstrates significantly better performance than the Decision Tree Classifier across all evaluated metrics. The SVM achieves an accuracy of 90.91%, a precision of 90.83%, a recall of 92.87%, and an F1-score of 91.15%, indicating its strong ability to correctly classify instances and maintain a balance between precision and recall. In contrast, the Decision Tree Classifier shows substantially lower accuracy at 63.64%, with precision, recall, and F1-score around 63-65%, reflecting a comparatively weaker ability to generalize and classify data accurately. This highlights that the SVM is a more effective model for this particular task, likely due to its capability to find optimal decision boundaries in complex datasets.

Figure 6: Output Predicted Hand injury.

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

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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