International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

LITERATURE SURVEY ON CERVICAL SPINE FRACTURE DETECTION USING DEEP LEARNING

Prof. Deepali Dhadwad[1],Tejas Dhande[2], Yugandhar Sarode[3], Predeep Dhebe[4], Tushar Sarje[5]

Indira College of Engineering and Management , pune

ABSTRACT :

The cervical spine is made up of the first seven vertebrae in the spine. A cervical spine fracture is a break in the bones of the neck. Serious cases can lead to spinal instability and neurological issues, demanding urgent intervention. Spine fractures are difficult to diagnose and cannot be readily understood. X-rays, CT scans, MRAs, and physical examination techniques are utilized to discover these fractures. Conventional models may not be robust to variations in scale and rotation, making it challenging to accurately detect fractures in images with different orientations or resolutions. To get beyond these limitations; automated systems are needed. Deep learning models, which are commonly used in modern approaches, excel at learning hierarchical representations. This study uses a deep neural network and the fifth iteration of You Only Look Once (YOLO) to identify vertebral column dislocations. Deep neural networks are utilized to categorize normal and broken vertebrates, while the purpose of YOLO v5 is to detect both large and small fractures of the C1 through C7 vertebrae. The model is trained using a training dataset that is supplied by ASNR and ASSR spine radiology professionals. In training and validation, the proposed model achieves classification accuracy of 97.7% and 89%, respectively., according to experimental results. The suggested technique outperforms the current one and can pinpoint the precise location of a cervical spine fracture.

Keywords: Cervical Spine Fracture Detection , YOLO Object Detection , Deep Learning in Medical Imaging , X-ray Image Analysis , Automated Diagnosis , Flask Web Application Medical Image Classification , HIPAA Compliance , Data Privacy in Healthcare , Fracture Localization , Medical Image Processing

1. Introduction:

The cervical spine is the highest segment of the cervical vertebral column and is located in the area surrounding the neck. It is composed of seven vertebrae, designated C1 through C7. It is accountable for supporting the head's weight, allowing for head movement, protecting the spinal cord, and providing locations of attachment for muscles and ligaments (Masudur Rahman Al Arif, Knapp, and Slabaugh 2018). The cervical spine is crucial for preserving the body's posture and equilibrium, as well as in the sensory and motor functions of the upper limbs. The first two, Atlas and Axis, are given unique names while being equally specialized. More conventional vertebrae, the C3–C7 have a body, pedicles, laminae, spinous processes, and facet joints (Naguib et al. 2023). The identification of fractures in the cervical spine is very important for the diagnosis aw well as treatment of injuries to neck and backbone. Cervical spine fractures can be found using a variety of approaches and procedures, such as imaging tests and clinical assessment. The most used technique for identifying cervical spine fractures is imaging studies. Since X-ray imaging is widely accessible, reasonably priced, and offers good visualization of the neck's bony structures, it is frequently the initial imaging modality utilized to assess cervical spine fractures (Bar, Wolf, and Bergman Amitai 2017).

2. Literature Survey:

In this literature survey, we delve into the research efforts aimed at employing YOLOv5 for cervical spine fracture detection. We explore the methodologies, datasets, and findings of various studies in this domain, with the goal of offering a thorough summary of the state-of-the-art at the moment, as well as identifying challenges and opportunities for future research.

By synthesizing the findings from multiple sources, this survey aims to contribute to the understanding of the capabilities and limitations of YOLOv5 in the context of cervical spine fracture detection, ultimately paving the way for more effective and efficient diagnostic tools in clinical practice. Now, let's delve into the papers researched in this survey, examining their methodologies, results, and implications for cervical spine fracture detection using YOLOv5.

Deep Learning and Cloud-Based Computation for Cervical Spine Fracture Detection System-pawel chlad and Marek R. Ogiela Through appropriate augmentation procedures, ViTs demonstrate comparable performance to CNNs, achieving competitive accuracy levels ranging from 90% to 98% in detecting vertebrae damage based on CT scan slices. Cervical Spine Fracture Evaluation- Moira Davenport, MD; Chief Editor: Trevor John Mills, MD, MPH more...

The epidemiological data emphasizes how common it is for patients with blunt trauma to report to the emergency department (ED) with thoracolumbar fractures and cervical spine injuries. These injuries are quite common in trauma settings, with thoracolumbar fractures occurring in 4-7% of patients and cervical spine injuries occurring in 3-4% of cases..

Performance study of YOLO v5 and Faster CNN for autonomous navigation by Trupti Mahendrakar, Andrew Ikbal and more.

Based on the testing dataset, it was shown that Faster R-CNN outperforms YOLOv5, However, YOLOv5 is a better real-time object detector for this application because it has a ten-fold higher inference rate than Faster R-CNN with the goal of offering a thorough summary of the state-of-the-art at the moment, Cervical Spine Fractures Overview

Fractures of the cervical spine are dangerous injuries that can have severe neurological consequences. Therefore, any further evaluation and therapy should be performed by a qualified spine expert. To guarantee ongoing cervical stability and healing, all patients with cervical fractures should get continuous monitoring and follow-up care

3. Proposed Methodology:

he Methodology of the suggested model has been thoroughly covered in this section..

Utilizing YOLOv5 for cervical spine fracture detection via deep learning presents a streamlined and efficient approach, enabling rapid and accurate identification of potential fractures within X-ray images. Its real-time detection capabilities minimize the need for manual inspection, reducing the risk of human error and ensuring timely diagnoses. YOLOv5's scalability and adaptability allow for robust performance across diverse patient cases and imaging conditions, while its integration with existing workflow systems enhances the efficiency of healthcare professionals. Moreover, continuous improvement through deep learning ensures the model's relevance and effectiveness in the evolving landscape of cervical spine imaging, making it a valuable tool for enhancing patient care outcomes.

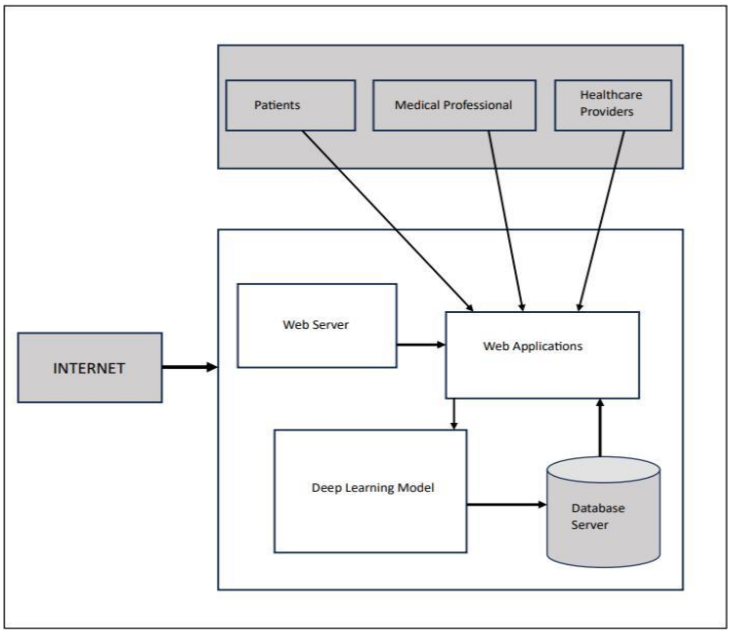
4. Mathematical representations :

Mathematically, YOLOv5's algorithmic efficiency and optimization significantly reduce the time required for image analysis, thereby minimizing the number of X-rays needed for diagnosis and treatment planning, ultimately reducing radiation exposure for patients without compromising diagnostic accuracy. YOLOv5 detects cervical spine fractures by analyzing X-ray images pixel by pixel, leveraging its deep learning architecture to identify patterns and anomalies indicative of fractures. Through extensive training on labeled datasets, the model learns to distinguish between normal anatomical structures and fractured regions, enabling precise localization and classification of fractures within the cervical spine. This automated detection process enhances the speed and reliability of fracture identification, facilitating prompt medical intervention and improving patient outcomes.

Let's represent the process mathematically:

1. Input Data: • Let I represent the input X-ray image.
2. Detection Process: • YOLOv5 processes the input image I using a deep neural network architecture, which can be represented as a function f(I).
3. Fracture Detection: • Within the neural network, multiple layers and operations are performed to detect potential fractures. Let's denote the output of the neural network as O, where O=f(I). • Each pixel in the output O represents a region of interest (ROI) in the input image I, with associated confidence scores for various classes (e.g., fracture, background).
4. Mathematical Representation: • Let Oij represent the confidence score associated with the ith ROI and the jth class. • We can define a threshold T such that if Oij ≥ T, the corresponding ROI is considered to contain a fracture. • Mathematically, the detection of a fracture can be represented as:
5. Localization and Classification: • Once a fracture is detected, the neural network provides information about its location and characteristics. This includes coordinates of the bounding box surrounding the fracture and possibly additional attributes (e.g., severity).

5. Proposed System Architecture



6. Future work and Conclusion :

One of the most crucial aspects of the diagnosis process is the timely and accurate detection of the spinal column.

Automated individual tools have advanced significantly in recent years, and it is expected that this trend will continue. With the use of deep neural networks, the suggested system will identify and quantify vertebral dislocations and accurately identify diagnostic techniques and assessment standards for possible cervical spine fracture injuries.

Radiologists will find the suggested Identification of Cervical Spine Fracture Using Deep Learning useful as a Clinical Decision Support System. In order to enable the creation Future research will focus on developing more comprehensive models that can evaluate alterations in spinal cord signaling, the degree of spinal cord compression, cervical spine deformity, and nerve root the construction of larger datasets.

7.REFERENCES :

1. Joseph H.McMordie, Vibhu Krishnan Viswanathan,Christopher C. Gills, “Cervical Spine Fractures Overview” 2023.
2. L. Manikandan1, Rapelli Malavika, Borlakunta Anjali, Sathuri Chandana, “Object Detection using YOLO V5” , 2023.
3. Trupti Mahendrakar, Markus Wilde, “PerformanceStudy Of YOLOv5 and Faster R-CNN for Autonomous Navigation around Non-Cooperative Targets”,2022 , https://ieeexplore.ieee.org/document/9843537
4. Satya Prakash Yadav, Muskan Jindal, Preeti Rani, Victor Hugo C. de Aluquerque, “An Improved Deep Learning-based Optical Object Detection System from Images”, 2023, https://doi.org/10.1007/s11042-023-16736-5
5. Rinisha bagaria, Arun Kumar Wadhwani, Sulochana Wadhwani, “Bone Fracture Detection in X-ray Images using ConvolutionalNeural Networ 2022, https://doi.org/10.52458/978-93-91842-08-6-43.
6. K Thaiyalnayaki , L Kavyaa , Joshua Sugumar,“Automated Bone Fracture Detection Using Convolutional Neural Network” 2023 https://doi.org/10.1088/1742- 6596/2471/1/012003
7. Nidharshan S. Anandasivam , Nathaniel T. Ondeck , Paul S. Bagi , Anoop R. Galivanche , Andre M. Samuel , Daniel D. Bohl , Jonathan N. Grauer ,
8. “Spinal fractures and/or spinal cord injuries are associated with orthopedic and internal organ injuries in proximity to the spinal injury”, https://doi.org/10.1016/j.xnsj.2021.100057
9. Eric Whitney , Anthony J. Alastra , “VertebralFracture”2023 , https://www.ncbi.nlm.nih.gov/books/NBK547673/ J.E. Small , P. Osler, A.B. Paul and M. Kunst , “CT Cervical Spine Fracture Detection Using CNN”2021, https://www.ajnr.org/content/42/7/1341
10. Pawel Chlad , Marek R. Ogiela , “Deep-Learning and Cloud -Based Computation for Cervical Spine Fracture Detection System” 2023 https://doi.org/10.3390/electronics12092056
11. H. Salehinejad , Edward Ho , Hui-Ming Lin , priscilla Crivellaro , O. Samorodova , Monica Tafur Arciniegas, Zamir Merali , K. Yeom , Aditya Bharatha , J. Wilson , E. Collak, “Deep Sequential Learning For Cervical Spine Fracture Detection OnComputed Tomography Imaging” , 2021 , https://doi.org/10.1109/ISBI48211.2021.9434126
12. S. M. Naguib , H.M. Hamza, K.M. Hosny ,M.K.Saleh and M.A. Kassem , “Classification OfCervical Spine Fracture and Dislocation Using Refined Pre-Trained Deep Model and Saliency Map”, 2023 , https://doi.org/10.3390/diagnostics13071273
13. Showmick Guha Paul , Arpa Saha , Md Assaduzzaman , “A real-time deep learning approach for classifying cervical spine fractures” 2023 , https://doi.org/10.1016/j.health.2023.100265
14. Moira Davenport , MD , Chief Editor : TrevorJohn Mills , MD , MPH , “Cervical Spine Fracture Evaluation https://emedicine.medscape.com/article/824380