IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 1, January 2026

DOI: 10.17148/IJARCCE.2026.15169

Automated Classification of Rare Cancers Using Deep Learning and Medical Imaging Data

Prof. Shwetha.S[1], Sahana.S[2]

Assistant Professor, Department of Computer Science & Engineering, JSS Science and Technology University

Mysuru, Karnataka, India [1]

PG Scholar, Department of Computer Science & Engineering, JSS Science and Technology University

Mysuru, Karnataka, India[2]

Abstract: This study presents the development of an advanced deep learning–based system for the automated detection of synovial sarcoma from microscopic soft tissue images using Convolutional Neural Networks (CNNs). Synovial sarcoma is a rare and highly aggressive subtype of soft tissue sarcoma, where accurate and early diagnosis is essential for effective clinical management and improved patient prognosis. The proposed CNN framework is designed to automatically extract and learn discriminative features from histopathological images, enabling reliable identification of patterns characteristic of synovial sarcoma. By minimizing manual interpretation and inter-observer variability, the system serves as a supportive diagnostic tool for pathologists, enhancing diagnostic accuracy and efficiency. The results demonstrate the potential of deep learning techniques in improving histopathological analysis and contributing to timely and precise cancer diagnosis.

I. INTROUDCTION

Synovial sarcoma is a rare type of soft tissue cancer that is difficult to detect early because it shows different patterns under a microscope. Diagnosing this disease usually depends on the careful examination of tissue samples by expert pathologists. In this project, a deep learning approach using Convolutional Neural Networks (CNNs) is proposed to automatically detect synovial sarcoma from microscopic images. The use of CNNs helps analyze complex tissue structures more quickly and consistently than manual methods, thereby supporting pathologists in improving diagnostic accuracy and efficiency.

Problem Statement:

Synovial sarcoma is a rare and aggressive soft tissue cancer that is difficult to diagnose accurately at an early stage due to its varied histological appearance. Traditional diagnosis relies on the manual microscopic examination of tissue samples by experienced pathologists, which is time-consuming and may be affected by human error and subjectivity. In many cases, limited availability of expert pathologist's further delays diagnosis. Therefore, there is a need for an automated and reliable system that can assist in the early and accurate detection of synovial sarcoma from microscopic images. This project aims to address this challenge by using Convolutional Neural Networks (CNNs) to analyze histopathological images and support pathologists in improving diagnostic accuracy and efficiency.

II. LITERATURE SURVEY

1. Deep Feature Learning for Soft Tissue Sarcoma Classification in MR Images via Transfer Learning
Authors: Haithem Hermessi, Olfa Mourali, Ezzeddine Zagrouba
This work uses transfer learning with CNNs to classify soft tissue sarcomas from MRI images. Image fusion techniques and a fine-tuned AlexNet model improved classification accuracy, showing the effectiveness of deep feature learning in medical diagnosis.

2. Improvement in Automated Diagnosis of Soft Tissue Tumors Using Machine Learning
Authors: El Arbi Abdellaoui Alaoui, Stéphane Cédric Koumetio Tekouabou, Sri Hartini
This study proposes a machine learning–based approach using preprocessing, resampling, and classifiers such as SVM and Decision Tree to reduce misdiagnosis of soft tissue tumors. The method showed improved diagnostic performance on clinical MRI data.

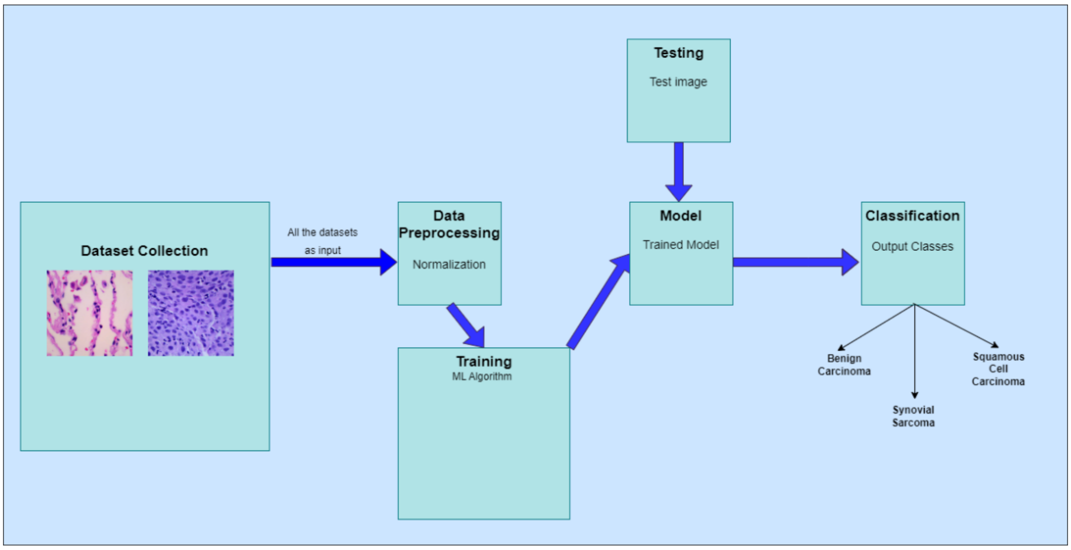
3. Artificial Intelligence for Classification of Soft-Tissue Masses at Ultrasound
Authors: Benjamin Wang, Laetitia Perronne, Christopher Burke, Ronald S. Adler

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 1, January 2026
DOI: 10.17148/IJARCCE.2026.15169

This research applies CNN models to classify benign and malignant soft tissue masses using ultrasound images. The AI model achieved performance comparable to expert radiologists, demonstrating the potential of deep learning in medical imaging.

4. Diagnosis, Classification, and Treatment of Sarcoma in the Era of Artificial Intelligence and Immunotherapy
Authors: Amandine Crombé, Matthieu Roulleau-Dugage, Antoine Italiano
This review discusses the role of artificial intelligence, radiomics, and digital pathology in improving sarcoma diagnosis and treatment. It highlights current challenges and future possibilities, including the potential of immunotherapy for sarcoma management.

III. METHODOLOGY



The methodology of the proposed system follows a sequential workflow, starting from data acquisition and ending with final classification. Each stage in the flowchart represents a critical operation that contributes to accurate cancer image classification.

The process begins with dataset collection, where medical images related to different cancer types are gathered from reliable and authenticated sources. These images include samples of benign carcinoma, synovial sarcoma, and squamous cell carcinoma. The collected dataset acts as the primary input to the system.

Next, the collected images are passed through the data preprocessing stage. In this step, all images are resized to a fixed dimension and pixel values are normalized. This ensures uniformity across the dataset and reduces unwanted variations. Proper preprocessing helps improve learning efficiency and reduces computational complexity.

Once preprocessing is completed, the images are forwarded to the training phase. Here, the deep learning algorithm learns to identify meaningful patterns and features from the input images. The model undergoes multiple training iterations, during which its internal parameters are continuously optimized to minimize classification errors. Gradually, the model becomes capable of distinguishing between different tumor types.

After training, a trained model is generated. This model stores the optimized weights and learned representations corresponding to each cancer class. It serves as the core decision-making unit of the system and is ready to handle new inputs.

The next stage in the flowchart is testing, where unseen medical images are provided to the trained model. These test images are processed using the same preprocessing techniques applied during training. Testing helps evaluate the model's accuracy, reliability, and generalization performance.

ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.471 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 15, Issue 1, January 2026

DOI: 10.17148/IJARCCE.2026.15169

Finally, the system reaches the classification stage. Based on the learned patterns, the model assigns the input image to one of the predefined categories—benign carcinoma, synovial sarcoma, or squamous cell carcinoma. The predicted class label is then displayed as the final output of the system.

IV. CONCLUSION

This Paper highlights the growing role of artificial intelligence and machine learning techniques in the diagnosis and classification of soft tissue sarcomas, particularly synovial sarcoma. The reviewed studies demonstrate that deep learning models, especially Convolutional Neural Networks, have shown promising results in analyzing medical images such as MRI, ultrasound, and histopathological data. These approaches improve diagnostic accuracy, reduce dependence on manual interpretation, and support clinicians in handling the complexity and heterogeneity of soft tissue tumors. However, challenges such as limited datasets, class imbalance, and lack of standardized evaluation methods remain. Overall, the findings indicate that AI-based diagnostic systems have strong potential to enhance early detection and clinical decision-making, emphasizing the need for further research and real-world validation to enable reliable adoption in healthcare environments.

REFERENCES

[1]. W.Wang,J.A.Ozolek,D.Slepcev,A.B.Lee,C.Chenet al., “An optimal transportation approach for nuclear structure based pathology,” IEEE Transactions on Medical Imaging, vol. 30, no. 3, pp. 621–631, 2015.

[2]. M. D. Murphey, M. S. Gibson, B. T. Jennings, A. M. Crespo-Rodriguez, J. Fanburg-Smith et al., “From the archives of the AFIR: Imaging of synovial sarcoma with radialogic-pathology correlation,” Radiographics: A Review Publication of the Radiology of the Society of North America, Inc., vol. 26, no. 5, pp. 1543–1565, 2006.

[3]. A. Kerouanton, I. Jimenez, C. Cellier, V. Laurence, S. Helfre et al., “Synovial sarcoma in children and adolescents,” Journal of Pediatric Hematology/Oncology, vol. 36, no. 4, pp. 257–262, 2014.

[4]. K. Thway and C. Fisher, “Synovial sarcoma: Defining features and diagnostic evolution,” Annals of Diagnostic Pathology, vol. 18, no. 6, pp. 369–380, 2014.

[5]. G.Rea,F.Somma,T.Valente,G.Antinolfi,G.D.Greziaet al., “Primary mediastinal giant synovial sarcoma: A rare case report,” The Egyptian Journal of Radiology and Nuclear Medicine, vol. 46, no. 1, pp. 9–12, 2015.

[6]. R. Ershadi, M. Rahim and H. Davari, “Primary mediastinal synovial sarcoma: A rare case report,” International Journal of Surgery Case Reports, vol. 27, pp. 169–171, 2016.

[7]. K. J. Khouzani and H. S. Zadeh, “Mutiwavelet grading of pathological images of prostate,” IEEE Transactions on Biomedical Engineering, vol. 50, no. 6, pp. 697–704, 2003