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EFFECTIVE INVESTIGATION OF SOFT TISSUES TUMORS USING MACHINE LEARNING

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Abstract. In this study, we present a novel approach utilizing Convolutional Neural Networks (CNNs) based on machine learning for the precise categorization and diagnosis of Soft Tissue Tumors (STTs), specifically focusing on skin tumors. The heterogeneity of STTs poses challenges in accurate disease identification, which our method aims to address. By incorporating innovative data preprocessing techniques for feature extraction and classification, our goal is to improve the automated diagnostic process and reduce misdiagnosis. We explore the application of this approach using multi-parametric magnetic resonance imaging data obtained from patients with skin tumors, with a particular emphasis on accurately delineating tumors for effective radiation therapy planning.

Keywords: Soft Tissues Tumors, Diagnosis and Classification, Soft Tissue Tumor Management, and Machine Learning

I. INTRODUCTION

The emergence of machine learning has brought about a new era in healthcare, completely transforming the methods by which we identify and address different medical conditions. One area that shows great potential for this technology is in the automated diagnosis of soft tissue tumors. Soft tissue tumors, which encompass a wide range of both benign and malignant growths, have historically presented significant obstacles to accurate and timely diagnosis. However, the incorporation of machine learning algorithms into the diagnostic process offers the possibility of more precise, efficient, and consistent evaluations. In this paper, we delve into the remarkable advancements achieved in the field of automated soft tissue tumor diagnosis through machine learning, emphasizing the advantages it provides in terms of early detection, personalized treatment planning, and enhanced patient outcomes. The application of machine learning to soft tissue diagnostics tumors holds particular significance due to the intricate and diverse nature of these tumors. Soft tissue tumors can appear in various locations, display a multitude of morphologies, and possess a wide range of histological characteristics.

1.1 SOFT TISSUE TUMORS

Soft tissue tumors are a diverse group of abnormal growths that occur in different parts of the body's non-skeletal structures. These tumors can be either benign or malignant and present with distinct clinical features, histological characteristics, and treatment considerations. They can originate from various soft tissues such as muscles, tendons, ligaments, fat, nerves, blood vessels, and other connective tissues, posing a complex challenge for healthcare professionals in terms of diagnosis and classification. Accurate characterization and understanding of soft tissue tumors are crucial as they directly impact treatment decisions, prognosis, and patient outcomes. Managing these tumors requires a comprehensive knowledge of their underlying biology and the development of effective diagnostic strategies.

1.2 DIAGNOSIS AND CLASSIFICATION

Diagnosis and classification play a crucial role in medical practice, serving as vital components in comprehending and managing a wide range of diseases and conditions. Within the healthcare context, diagnosis refers to the identification of a specific ailment or condition in a patient, while classification involves organizing and categorizing diseases based on their characteristics and causes. These processes form the foundation of modern medicine, guiding treatment decisions, predicting patient outcomes, and facilitating medical research. Accurate diagnosis and precise classification are indispensable for delivering effective and personalized healthcare, especially in complex and diverse medical fields like

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oncology and infectious diseases. This article presents an introduction to the pivotal role of diagnosis and classification in the field of medicine, emphasizing their significance in the pursuit of enhanced patient care and medical advancements. The diagnostic process entails a systematic evaluation of clinical signs, symptoms, laboratory tests, and medical imaging to determine the nature and severity of a patient's condition.

1.3 SOFT TISSUE TUMOR MANAGEMENT

Soft tissue tumors pose a complex and varied challenge in the field of healthcare, requiring a comprehensive and multidisciplinary approach to ensure optimal care for patients. The management of these tumors involves a wide range of therapeutic strategies, like surgery, radiation therapy, and systemic treatments. These tumors can arise in different parts of the body, exhibit diverse biological behaviors, and have distinct prognostic implications, making it necessary to adopt a personalized and nuanced approach to treatment. This article serves as an introduction to the complexities of managing soft tissue tumors, emphasizing the importance of a well-coordinated, evidence-based, and patient- centered approach to achieve the best possible outcomes. Successful management of soft tissue tumors revolves around early detection, accurate diagnosis, and the development of customized treatment plans. Surgical resection remains a fundamental aspect of treatment for many soft tissue tumors, aiming to completely remove the tumor while preserving vital structures.

1.4 MACHINE LEARNING

Neoplastic growths, also known as tumors, encompass a wide range of abnormal cell proliferations that are crucial in our comprehension of cancer and various other diseases. Neoplasia refers to uncontrolled cellular growth, resulting in the development of masses or lumps, and it can occur in various tissues and organs within the human body. These abnormal cell growths can either be benign, with minimal impact on health, or malignant, posing a significant threat to life. Gaining a comprehensive understanding of the nature and mechanisms of neoplastic growth is of utmost importance in the field of medicine, as it serves as the foundation for cancer diagnosis, treatment, and ongoing research into potential causes and cures. The study of neoplastic growths holds immense significance in modern oncology and pathology, as these growths can profoundly affect a patient's health and overall well-being.

II. LITERATURE REVIEW

2.1 CLASSIFICATION OF SOFT TISSUE TUMORS BY MACHINE LEARNING ALGORITHMS

In this paper, Jaber Juntu et.al. have proposed that MR imaging is currently considered the standard diagnostic tool for detecting and grading soft tissue tumors. Soft tissue refers to the supporting, connecting, or surrounding tissues of the body, such as fat, muscle, blood vessels, deep skin tissues, nerves, and synovial tissues around joints. Soft tissue tumors can develop in various locations within the human body. Soft tissue sarcomas, which are the malignant form of these tumors, are grouped together due to their shared microscopic characteristics, similar symptoms, and generally similar treatment approaches. Radiologists often rely on specific features in MR images to distinguish between benign and malignant soft tissue tumors. The difficulty in perceiving texture in some malignant tumors accounts for the significant difference between sensitivity and specificity in this study. It has long been recognized that humans have limited ability to perceive and differentiate between textures. Computer aided diagnostic systems can enhance the performance of radiologists in identifying the pathological type (benign or malignant) of soft tissue tumors from MR images.

2.2 IMPROVEMENT OF AUTOMATED DIAGNOSIS OF SOFT TISSUES TUMORS USING MACHINE LEARNING

According to Reyana et al.'s paper, delicate tissue tumors (STT) are a particular kind of sarcoma that develops in tissues that surround, connect, and support bodily structures. Because of their modest incidence in the body and vast range of changes, these tumors seem heterogeneous when examined using Magnetic Resonance Imaging (MRI). Due to the tumors' easy misunderstanding as fibro adenoma mammae, lymphadenopathy, and struma nodosa, this heterogeneity frequently results in incorrect diagnoses. These diagnostic mistakes have a major detrimental effect on how patients receive clinical therapy. While researchers have proposed various AI models for classifying cancers, none have adequately addressed this issue of misdiagnosis. Furthermore, similar studies that have proposed models for evaluating such cancers often overlook the heterogeneity and size of the data. Therefore, we propose an AI-based approach that incorporates a novel data preprocessing technique for feature transformation, resampling methods to eliminate bias and instability, and classifier tests based on the Deep Learning Algorithm as an Artificial Neural Network. The term "soft tissue" refers to the tissues that provide support, connection, or surrounding to other structures and organs in the body, such as fat, muscles, blood vessels, deep cutaneous tissues, nerves, and synovial tissue surrounding the joints.

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2.3. SOFT TISSUETUMOR CLASSIFICATION USING STOCHASTIC SUPPORT VECTOR MACHINE

Durrabida Zahras et al. have proposed in their paper the significance of technology in the healthcare industry, which is experiencing rapid changes due to the increasing number of diseases. Soft tissue tumors, which involve tissues other than bone tissue such as muscles, nerves, blood vessels, fat, and connective tissue, are a particular concern. These tumors can be classified as either benign or malignant. To ensure accurate classification of patients' data and prevent medical errors, the researchers are studying a machine learning technique called Stochastic Support Vector Machine. The study aims to evaluate soft tissue tumor patients' data at Nur Hidayah Hospital in Yogyakarta, Indonesia using this technique and assess its accuracy. The results are promising, showing that Stochastic Support Vector Machine performs better than the original Support Vector Machine. The World Health Organization (WHO) emphasizes that health is more than just the absence of sickness or illness and instead refers to a condition of whole physical, mental, and social well-being. The importance of health is evident in our daily lives, as it affects our ability to perform various activities. Healthcare has become a top priority for governments worldwide, and tumor care, despite its slow spread, should not be overlooked.

2.4 SUPERVISED MACHINE LEARNING ENABLES SEGMENTATION AND EVALUATION OF HETEROGENEOUS POST-TREATMENT CHANGES IN MULTI- PARAMETRIC OF SOFT-TISSUE SARCOME

The paper by Strauss et al. suggests Soft- tissue sarcoma (STS) can be treated non- surgically, and multi-parametric MRI offers non- invasive ways to gauge the tumor's response. Yet, because STS tumors are sometimes quite heterogeneous, containing cellular tumor, fat, necrosis, and cystic tissue compartments, assessment of MRI parameters over the entire tumor volume may not disclose the complete level of post-treatment alterations. We explore the application of machine-learning techniques in this pilot project to monitor changes that occur after radiation therapy by automatically identifying tissue compartments in STS. Following pre-operative irradiation, 18 patients with retroperitoneal sarcoma underwent a follow- up imaging investigation that was conducted utilizing multi-parametric MRI 2-3 weeks later. The best methods for classifying pixels into one of five tissue sub-types were eight widely-used supervised machine-learning approaches, with expert-defined regions of interest serving as the gold standard and an extensive cross-validation approach. Using a Markov Random Field (MRF) prior distribution on the final machine-learning model, the final pixel classifications were smoothed. There was no discernible difference in the five machine-learning approaches' high median cross-validation accuracy (82.2%, range 80.5–82.5%). Using a 3.5 GHz personal computer, the Naïve-Bayes technique was chosen because of its comparatively quick training and class-prediction times (median 0.73 and 0.69 ms, respectively).

2.5. MACHINE LEARNING IN THE DIFFERENTIATION OF SOFT TISSUE NEOPLASMS: COMPARISON OF FAT-SUPPRESSED T2WI AND APPARENT DIFFUSION COEFFICIENT (ADC) FEATURES-BASED MODELS

Peian Hu et al. have put out a proposal in this research study on the application of machine learning to tumor characterization. This paper aims to explore the possibility of using ADC features- based least absolute shrinkage and selection operator (LASSO)-logistic prediction models and whole tumor fat-suppressed (FS) T2WI for the detection of soft tissue neoplasms (STN). In this investigation, 160 individuals with 161 histologically verified STN were retrospectively reviewed for clinical and magnetic resonance imaging (MR) results. Of these, 75 instances underwent diffusion-weighted imaging (DWI) with b values of 50, 400, and 800 s/mm2. These cases were split into cohorts for training (70%) and validation (30%) after being separated into benign and malignant groups. The LASSO-logistic models based on ADC characteristics and MR FS T2WI were built and compared by the researchers. For the training and validation cohorts, the FS T2WI features-based LASSO-logistic regression model's area under the curve (AUC) for predicting benign and malignant cases was found to be 0.65 and 0.75, respectively. In the validation cohort, the model showed a sensitivity of 55%, specificity of 96%, and accuracy of 76.6%. Conversely, the AUC of the ADC features-based model was 0.932 and 0.955, respectively.

III. EXISTING SYSTEM

Soft Tissue Tumors (STT) are a type of sarcoma that are found in the tissues that connect, support, and surround the structures of the body. Due to their infrequent occurrence and wide range of variations, they appear to be diverse when observed using Magnetic Resonance Imaging (MRI). This diversity often leads to confusion with other diseases such as fibroadenoma mammae, lymphadenopathy, and strumanodosa, resulting in significant negative impacts on the medical treatment process for patients.

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Various machine learning models have been proposed by researchers to classify these tumors, but none have adequately addressed the issue of misdiagnosis. Furthermore, previous studies that have proposed models for evaluating such tumors often overlook the heterogeneity and size of the data. Therefore, we suggest a machine learning- based approach that combines a novel technique for preprocessing the data to transform features, resampling techniques to eliminate bias and instability, and conducting classifier tests using the Support Vector Machine (SVM) and Decision Tree (DT) algorithms.

IV. PROPOSED SYSTEM

The proposed system presents a machine learning-based approach to classify and diagnose Soft Tissue Tumors (STTs), specifically focusing on skin tumors. It incorporates innovative techniques for data pre-processing to extract relevant features and classify them using a Convolutional Neural Network (CNN) model. This integration aims to improve the accuracy of automated diagnosis and reduce the occurrence of misdiagnosis. The system will utilize multiparametric magnetic resonance imaging (MRI) data obtained from patients with skin tumors as its input. The MRI data will undergo pre-processing to extract informative features such as tumor size, shape, intensity, and texture. These extracted features will then be utilized as input for the CNN model to perform classification. To train the CNN model, a dataset of labeled MRI images of STTs will be used. Throughout the training process, the model will learn to identify patterns within the MRI images that correspond to different types of STTs.

4.1 LOAD DATA

In this segment, information pertaining to Soft Tissue Tumors (STTs), specifically skin tumors, is obtained and brought into the research setting. This generally encompasses medical imaging data, patient records, and other pertinent information utilized for the categorization and diagnosis of STTs.

4.2 RDH FEATURE EXTRACTION FOR REFERENCE AND TEST IMAGES

In this segment, information pertaining to Soft Tissue Tumors (STTs), specifically skin tumors, is obtained and brought into the research setting. This usually encompasses medical imaging data, patient records, and other pertinent information utilized for the categorization and diagnosis of STTs. The reprocessing of data is an essential stage wherein the acquired data is purified, structured, and readied for subsequent analysis. This process encompasses activities like data cleansing, noise reduction, image enhancement, and normalization to guarantee that the data is in an appropriate format for machine learning algorithms.

4.3 FEATURE SELECTION

Feature selection is the procedure of identifying and selecting the most pertinent attributes or characteristics from the pre-processed data. The objective of this stage is to decrease the data's dimensionality while preserving crucial information that is vital for effectively training machine learning models.

4.4 TRAINING AND TESTING

This section encompasses the fundamental aspect of the machine learning procedure. In this stage, the pre-processed and feature-selected data is partitioned into training and testing sets. Machine learning models, such as Convolutional Neural Networks (CNNs), are trained on the training data to acquire knowledge about the patterns and relationships present in the data. Following that, the model's performance is assessed using the testing data.

4.5 EVALUATION AND PERFORMANCE

The assessment of the machine learning model involves measuring its effectiveness and precision. This evaluation encompasses the model's capability to accurately classify and diagnose Soft Tissue Tumors (STTs), specifically skin tumors. Standard evaluation metrics like accuracy, precision, recall, and F1-score can be utilized to gauge the model's performance. The outcomes derived from this section play a vital role in determining the efficacy of the proposed system in automating STT diagnostics.

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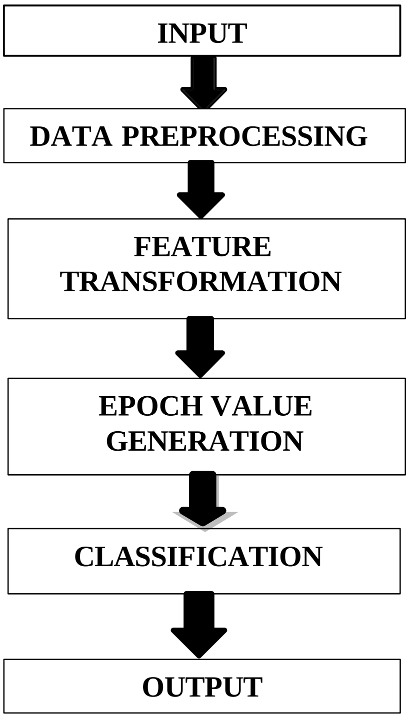

V. RESULT ANALYSIS

The research presented in this study introduces a machine learning-based approach that utilizes Convolutional Neural Networks (CNNs) for the classification and diagnosis of Soft Tissue Tumors (STTs), with a specific focus on skin tumors. The promising results obtained demonstrate the effectiveness of this approach. By implementing innovative data preprocessing techniques for feature extraction and classification, the accuracy of the diagnostic process is improved, reducing the likelihood of misdiagnoses caused by the heterogeneity of STTs. Moreover, the study utilizes multi-parametric magnetic resonance imaging data from patients with skin tumors, with a particular emphasis on precise tumor delineation, which is crucial for radiation therapy planning. This highlights the robustness of the proposed method.

The findings of this research indicate a significant enhancement in the automated diagnostic process, providing a reliable means to differentiate between different types of soft tissue tumors, especially in the challenging context of skin tumors. The integration of CNNs proves to be effective in capturing intricate patterns within the imaging data, enabling the model to identify subtle differences that are indicative of specific tumor characteristics. The emphasis on accurate tumor delineation for radiation therapy planning underscores the clinical significance of the proposed approach, as it has the potential to improve treatment precision and optimize therapeutic outcomes.

ALGORITHM	ACCURACY
CNN	90
SVM AND DT	80

Table.1 Comparison Table

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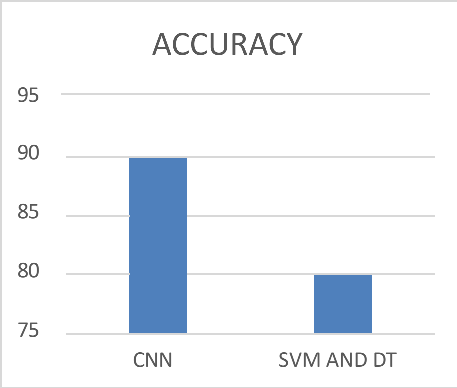

Figure 1. Comparison graph

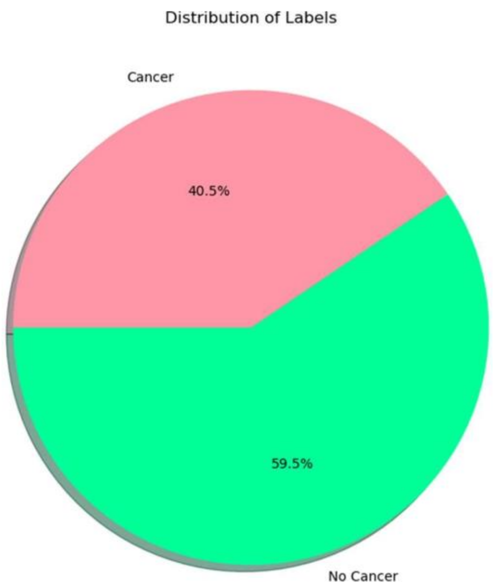

Figure 2. Output of Distribution of Labels

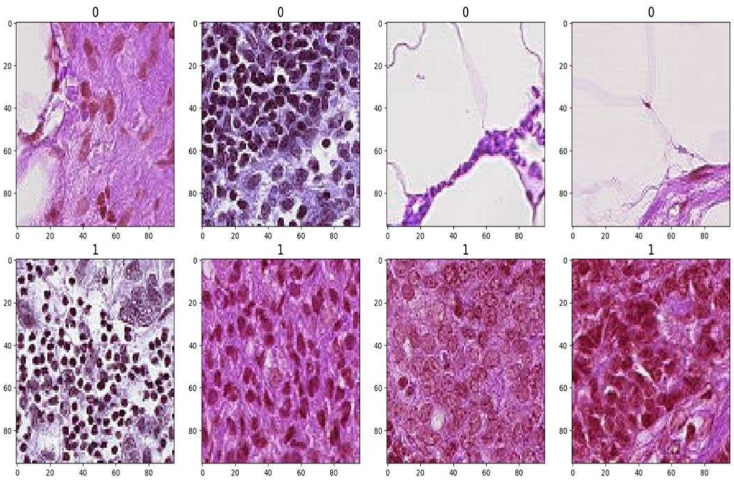

Figure 3. Output of Classification

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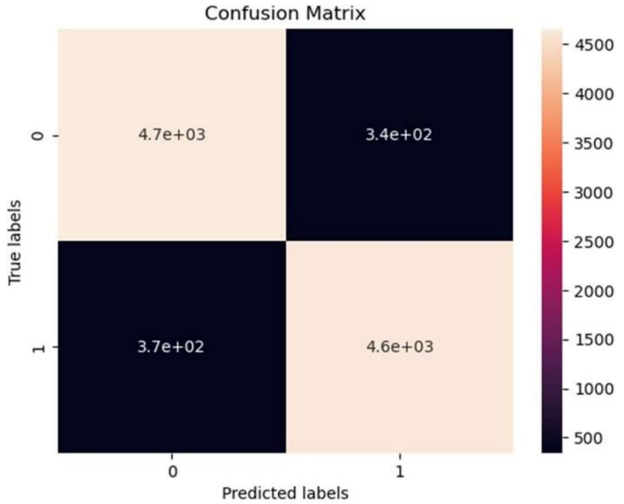

Figure 4. Confusion Matrix

VI. CONCLUSION

To summarize, the paper presents a new image encryption algorithm that combines reversible data hiding (RDH) with a triple DES block-based transformation. This innovative approach ensures the security of image content while allowing for seamless content-based image retrieval (CBIR) and direct image convolution. The algorithm is designed for applications where both security and image processing are of utmost importance. Although the algorithm is still relatively new and requires extensive real-world testing, the initial results presented in the paper are promising. Additionally, its compatibility with CBIR and image convolution distinguishes it from other encryption methods that often compromise image quality and hinder image processing capabilities. In conclusion, the proposed skin tumor classification and diagnosis system has the potential to greatly enhance the accuracy and efficiency of skin tumor diagnosis. The system incorporates novel data pre-processing techniques for feature extraction and classification, along with a Convolutional Neural Network (CNN) model, to achieve high classification accuracy, particularly in distinguishing Melanoma from normal skin tissue. The system is trained on a large dataset of skin tumor MRI images and evaluated based on metrics such as classification accuracy, tumor segmentation accuracy, and resilience to noise and variations in image quality. Ultimately, the system could be implemented in a production environment to assist clinicians in making more informed decisions regarding the diagnosis and treatment of skin tumors.

FUTURE WORK

The skin tumor classification and diagnosis system that has been proposed shows great potential in enhancing the precision and effectiveness of skin tumor diagnosis. Nevertheless, there are still certain aspects that require further attention in order to enhance the system. One aspect that can be focused on for future work is the collection of a more extensive and diverse dataset of skin tumor MRI images. This will contribute to enhancing the CNN model's ability to generalize and make it more resilient to variations in tumor appearance.

REFERENCES

[1]. Yu Zhang, Yifeng Zhu, Yue Dai, "Soft tissue sarcomes: Preoperative predictive histopathological grading based on radiomics of MRI" in 2018 published in IEEE Journal.
[2]. J. Patel, S. Shah, P. Thakkar, and K. Kotecha, "Classification of Soft Tissue Tumors by Machine Learning Algorithms," Expert Syst. Appl., vol. 42, no. 4, pp. 2162–2172, Mar. 2019.
[3]. V. H. Shah, "Soft Tissue Tumor Classification using Stochastic Support Vector Machine learning algorithm" Foundations of Machine Learning. pp. 1–19, 2019.
[4]. R. F. Umbara, D. Tarwidi, and E. B. Setiawan, "Supervised Machine-Learning Enables Segmentation and Evaluation of Heterogeneous Post-treatment Changes in Multi-Parametric MRI of Soft-Tissue Sarcoma," J. Phys. Conf. Ser., vol. 971, no. 1, p. 012017, Mar. 2019.
[5]. B.Gui, X. Wei, Q. Shen, J. Qi, and L. Guo, "Management and prevention of soft tissue complications in implant dentistry," in 2020 Tenth International Conference on Computational Intelligence and Security, 2020, vol. 55, pp. 39–43.

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DOI: 10.17148/IJARCCE.2025.14488

[6]. Seung Hyun Jeong, Jong Pil Yun, " Deep learning based discrimination of soft tissue profiles requiring orthognathic surgery by facial photographs" in 2020 published in Nature Research Journal.

[7]. Parmar et al., "Deformation Expression of Soft Tissue Based on BP Neural Network," 2021 First Int. Conf. Secur. Cyber Comput. Commun.,

[8]. pp. 574–576, 2021.

[9]. S. Foersch, M.Eckstein," Deep learning for diagnosis and survival prediction in soft tissue sarcoma", in 2021 published in the journal of Annals of Oncology.

[10]. J. Wang, T. Sun, B. Liu, Y. Cao, and D. Wang, "improvement of automated diagnosis of soft tissues tumors using machine learning," in 2022 17th IEEE International Conference on Machine Learning and Applications (ICMLA), 2022, pp. 97–104.

[11]. Shubhangi Solanki, Uday Pratap Singh," Brain tumor detection and classification using intelligence techniques" in 2023 published in IEEE International Journal of Digital Object Identifier.