



Treatment Determination for Soft Tissue Tumors by Automated Diagnosis

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ABSTRACT—

Soft Tissue Tumors (STT) are a structure of sarcoma discovered in tissues that connect, support, and encompass physique structures. Because of their shallow frequency in the physique and their fantastic diversity, they show up to be heterogeneous when found via Magnetic Resonance Imaging. They are without problems stressed with different ailments such as fibro adenoma mammae, lymphadenopathy, and struma nodosa, and these diagnostic blunders have a enormous unsafe impact on the clinical remedy procedure of patients. Researchers have proposed quite a few computing devices studying fashions to classify tumors, however none have appropriately addressed this misdiagnosis problem. Also, similar

Studies that have proposed fashions for assessment of such tumors commonly do now not think about the heterogeneity and the dimension of the data. Therefore, we suggest a computing device learning-based strategy which combines a new approach of preprocessing the facts for facets transformation, resampling methods to remove the bias and the deviation of instability and performing classifier checks primarily based on SVM, LR, Convolutional Neural Network (CNN), Decision Tree. These outcomes affirm that desktop studying strategies may want to furnish environment friendly and superb equipment to improve the automated decision-making strategies of STT diagnostics.

Key words: Machine Learning, Decision tree algorithm, Support vector computer (SVM) algorithm, Logistic Regression (LR), Convolutional Neural Network (CNN).

I. Introduction

Soft tissue sarcoma is a uncommon and heterogeneous crew of tumors that occur from the connective tissue of the body. The analysis and prediction of survival in smooth tissue sarcoma sufferers are quintessential for making therapy choices and enhancing affected person outcomes. Traditional techniques of prognosis and prognosis be counted on histopathological evaluation of tissue samples and scientific parameters, however these strategies are regularly restricted by using their subjectivity and lack of accuracy. Deep learning, a subset of desktop learning, has emerged as a effective device for inspecting scientific pics and predicting affected person outcomes. Deep gaining knowledge of algorithms can mechanically extract aspects from snap shots and different medical data, permitting for greater goal and correct prognosis and prediction. Overall, deep studying has the achievable to revolutionize the prognosis and prognosis of tender tissue sarcoma. By presenting greater correct and goal evaluation of clinical photos and scientific data, deep getting to know algorithms can assist clinicians make higher cure choices and enhance affected person outcomes. [1]. There are a diverse team of uncommon malignancies that occur from mesenchymal tissues, such as muscles, adipose tissue, nerves, and blood vessels. Accurate analysis and administration of STS continue to be challenging, as they are a heterogeneous crew of tumors with various medical and pathological features. It proposed a new histopathological grading machine based totally on these factors, which they located to be a considerable predictor of usual survival and disease-free survival in person STS patients. The proposed grading device may additionally additionally have implications for the improvement of new therapy techniques and the format of scientific trials in STS [2]. Neoadjuvant chemotherapy is regularly used as a remedy approach for STS to enhance the possibilities of profitable surgical resection and enhance affected person consequences and to enhance the prediction of response to neoadjuvant chemotherapy in STS sufferers the use of superior imaging techniques. The find out about analyzed facts from fifty-four STS sufferers who underwent neoadjuvant chemotherapy observed by using surgical resection and evaluated a number of imaging features, consisting of obvious diffusion coefficient (ADC), perfusion, and textural features, to predict therapy response. The find out about determined that combining imaging facets with medical variables expanded the prediction of response to neoadjuvant chemotherapy in STS patients. The authors additionally proposed a new imaging-based classification machine for STS based totally on remedy response, which they observed to be a vast predictor of disease-free survival and universal survival [3]. Head and neck STS are especially difficult to manipulate due to their complicated anatomy and the achievable for practical and beauty deficits after treatment. Head and neck STS account for solely 1% to 2% of all head and neck tumors and 10% to 15% of all STS. The most frequent histological kinds of head and neck STS are undifferentiated pleomorphic sarcoma, liposarcoma, and synovial sarcoma. The medical presentation of head and neck STS can fluctuate relying on the area and dimension of the tumor, however may additionally encompass a palpable mass, pain, paresthesia, or facial nerve weakness. The prognosis of head and neck STS is normally made with a mixture of imaging studies, such as magnetic resonance imaging (MRI) or computed tomography

(CT) scans, and a biopsy. Early prognosis and fantastic cure are quintessential for enhancing results for patients with head and neck STS[5]. STS can happen somewhere in the body, however the extremities and trunk are the most frequent sites, accounting for about 60% of cases. The analysis of STS generally includes a aggregate of scientific evaluation, imaging studies, and histological evaluation of tissue samples got by means of biopsy or surgical excision. The cure of STS commonly entails a multidisciplinary approach, consisting of surgery, radiation therapy, and chemotherapy, relying on the tumor stage, location, and histology. However, the most efficient therapy method for STS of the extremities and trunk stays controversial, and there is ongoing lookup aimed at enhancing the accuracy of diagnosis, predicting cure response, and lowering the chance of neighborhood recurrence and metastasis[7].

II. Related Work

There have been countless research in latest years that have explored the use of deep mastering for the prognosis and survival prediction of smooth tissue sarcoma. Here are a few examples of associated work: "Deep Learning for Soft Tissue Sarcoma Classification Using Magnetic Resonance Images" (Journal of Magnetic Resonance Imaging, 2018) - In this study, researchers developed a deep gaining knowledge of algorithm to classify smooth tissue sarcoma subtypes primarily based on MRI data. The algorithm done an accuracy of 86% in classifying the tumors. "Predicting Survival in Soft Tissue Sarcoma Using Treatment, Imaging, and Machine Learning" (Annals of Surgical Oncology, 2020) - In this study, researchers developed a computer getting to know mannequin to predict survival in tender tissue sarcoma sufferers based totally on remedy and imaging data. The mannequin completed an accuracy of 84% in predicting 3-year survival. "Survival Prediction for Soft Tissue Sarcoma Patients: A Deep Learning Approach Using Random Survival Forests" (IEEE Journal of Biomedical and Health Informatics, 2020) - In this study, researchers developed a deep getting to know method the usage of random survival forests to predict survival in smooth tissue sarcoma sufferers based totally on medical and genomic data. The strategy executed an accuracy of 73% in predicting 5-year survival[1]. This learn about aimed to furnish evidence-based suggestions that find out about highlighted the significance of histological subtype, grade, and stage in the administration of gentle tissue sarcoma patients. The authors endorsed a standardized pathological contrast for gentle tissue sarcoma specimens, consisting of evaluation of tumor size, margin status, and histological subtype and grade. The find out about additionally supplied practice on the administration of tender tissue sarcoma, which include surgical resection, radiation therapy, and systemic therapy. The authors emphasized the significance of multidisciplinary care and the involvement of skilled sarcoma groups in the administration of tender tissue sarcoma patients. The study's evidence-based tips can assist clinicians in making informed choices about the administration of these difficult malignancies, and the emphasis on multidisciplinary care can make certain most suitable results for patients[2]. "Magnetic Resonance Imaging Radiomics for Predicting Chemotherapy with the aid of Yu et al. (2020) - This learn about aimed to strengthen and validate a radiomics mannequin based totally on magnetic resonance imaging (MRI). The learn about determined that the radiomics mannequin used to be in a position of suitable accuracy[3]. The neoadjuvant and the usage core needle biopsy samples with the Prosigna assay in sufferers with smooth tissue sarcoma" by using Tanaka et al. (2018) - This find out about aimed to consider the use of the Prosigna assay, a gene-expression .The learn about discovered that the Prosigna assay used to be in a position neoadjuvant accurate accuracy. "Development and Validation of a Radiomic for Preoperative via Dong et al. (2020) - This find out about aimed to enhance and validate a radiomic nomogram based totally the points for predicting the grade of STS. The find out about discovered that the radiomic nomogram had appropriate accuracy in distinguishing intermediate-grade from high-grade STS. Radiomic aspects for response prediction in gentle tissue sarcoma dealt with with neoadjuvant chemotherapy" through Li et al. (2021) - This find out about aimed to discover radiomic aspects from computed tomography (CT) pix . The learn about observed that radiomic points ought neoadjuvant precise accuracy. "Soft-tissue sarcoma heterogeneity mirrored in MRI texture features: a pilot study" by way of Giannini et al. (2016) - This learn about aimed to consider the use of MRI texture elements for characterizing the heterogeneity of STS and predicting tumor grade. The find out about discovered that MRI texture elements have been in a position to distinguish between and with right accuracy [3,4]. "Radiomic aspects on MRI allow chance categorization of sufferers with diffuse soft-tissue sarcomas: A preliminary study through Huang et al. (2021) - This find out about aimed to improve and validate a radiomic mannequin based totally on MRI points for hazard categorization of sufferers with diffuse STS. The find out about discovered that the radiomic mannequin used to be in a position to predict the chance of disorder development and typical survival, and distinguish intermediate-grade from high-grade STS[4]. "A evaluation of literature" with the aid of Willems et al. (2016): This assessment article summarizes the contemporary proof on surgical administration of head and neck STS, along with surgical strategies and outcomes. "Role of adjuvant radiotherapy for head and neck gentle with the aid of Xu et al. (2018): This meta-analysis reviewed the literature on the function radiotherapy cure of head and neck STS. They determined that adjuvant radiotherapy elevated neighborhood manage and disease-free survival. "Proton beam remedy for head and neck tender tissue sarcoma: a case series" via Ohno et al. (2020): This case sequence describes the use of proton beam remedy for the remedy of head. The authors discovered that MRI-guided biopsy used to be a secure and correct technique for diagnosing tender tissue sarcomas, with a excessive sensitivity and specificity. In a systematic evaluation and meta-analysis, on neighborhood recurrence and survival in sufferers of living. These research spotlight significance of correct diagnosis, fantastic surgical margins, and multimodal therapy approaches and neck STS. The authors file favorable consequences with proton therapy, inclusive of excessive charges of neighborhood manipulate and low charges of toxicity[5]. Several research have investigated the use of desktop studying (ML) algorithms for the segmentation and comparison of tender tissue tumors on MRI images. For example, a learn about by way of Thawani et al. (2018) used a deep studying algorithm to routinely phase smooth tissue sarcomas on MRI images, reaching excessive accuracy in contrast to guide segmentation. In some other study, Zhang et al. (2020) developed a radiomics-based mannequin of smooth tissue sarcomas. In the context of post-treatment assessment of tender tissue tumors, a find out about via Yang et al. (2020) used a deep studying algorithm to robotically phase residual tumors on post-treatment MRI pictures in sufferers with tender tissue sarcomas. These research display the viable of ML algorithms, which includes deep gaining knowledge of and radiomics-based approaches, for the segmentation and comparison of tender tissue tumors on MRI images. The software of these methods should enhance the accuracy and effectivity of analysis and remedy planning for sufferers with gentle tissue sarcomas[6]. A find out about through Willeumier et al. (2019) investigated MRI-guided for the prognosis of gentle tissue

sarcomas. In a systematic evaluation and meta-analysis, Grimer et al. (2014). These research spotlight the significance of correct diagnosis, fantastic surgical margins, and multimodal therapy approaches [7].

III. Methodology Used

There are various works done on Soft tissue tumor treatment detection:

A. Statistical Analysis for soft tissue tumor treatment detection:

In research the usage of deep getting to know for the prognosis and survival prediction of smooth tissue sarcoma, statistical evaluation is an essential element of the methodology. Typically, statistical evaluation is used to consider the overall performance of the developed models, as properly as to pick out any massive associations between the mannequin predictions and affected person outcomes. One frequent statistical evaluation approach used in these research is receiver running attribute (ROC) analysis. ROC evaluation includes plotting the actual advantageous fee (sensitivity) in opposition to the false nice fee (1-specificity) for exceptional classification thresholds. An AUC of 0.5 shows that the mannequin is no higher than chance, whilst an AUC of 1.0 shows ideal performance. Overall, statistical evaluation performs a crucial function in the assessment of deep studying fashions for the prognosis and survival prediction of tender tissue sarcoma. By the usage of these techniques, researchers can decide the accuracy and predictive strength of the developed models, as nicely as become aware of

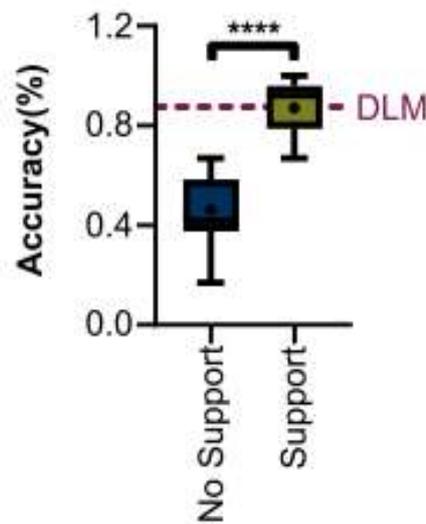


Fig.1. Accuracy graph

Possible biomarkers or remedy ambitions for similarly investigation[1].

B. Tumor Cellularity for the treatment detection:

Tumor cellularity refers to the proportion of tumor cells inside a given sample of tissue. It can be an essential aspect in the prognosis and remedy of tender tissue sarcomas, as greater ranges of tumor cellularity may additionally point out a extra aggressive cancer. The methodology for figuring out tumor cellularity commonly entails the examination of histological sections of the tumor tissue below a microscope. A pathologist will check the percentage of tumor cells current in the pattern and assign a share price primarily based on their observations. Other elements that may additionally be evaluated the gentle sarcomas encompass kind of the tumor, the diploma of differentiation positive molecular markers or genetic mutations. These elements can be used to decide the prognosis of the affected person and information remedy decisions. In phrases of treatment, the strategy to tender tissue sarcomas may also rely on a range of factors, which includes the dimension and region of the tumor, the stage of the cancer, and the normal fitness of the patient. Treatment preferences may additionally encompass surgery, radiation therapy, chemotherapy, or a mixture of these approaches. In some cases, focused treatment options or immunotherapy may additionally additionally be used to deal with tender tissue sarcomas[2].

C. Magnetic Imaging for fast detection and for providing better treatment:

This is a effective device and prognosis of tender tissue sarcomas. MR imaging can supply targeted facts about extent of the tumor, as properly close by constructions such as nerves and blood vessels. In addition to helping in the analysis of tender tissue sarcomas, MR imaging can additionally be used to assist predict the response of the tumor to treatment. For example, adjustments in the measurement or look of the tumor on MRI scans may additionally point out a high-quality response to treatment, whilst lack of alternate or development of the tumor can also recommend that the therapy is no longer effective. It can supply extra records about the tumor microenvironment, such as tissue cellularity, vascularity, and perfusion. This data can assist predict remedy response and information remedy decisions. In aggregate with different diagnostic and prognostic elements such as tumor histology, grade, and molecular markers, MR imaging can play an essential position in the administration of tender tissue sarcomas. By supplying targeted statistics about the tumor and its response to treatment, MR imaging can assist optimize cure techniques and enhance consequences for patients. Some specific ways are

involved they are-Tumor dimension and volume: MR imaging can precisely measure the dimension and extent of the tumor, which can be used to music modifications over time and investigate response to treatment.Tumor heterogeneity: Soft tissue sarcomas are frequently heterogeneous, with areas of various cellularity, vascularity, and necrosis. Advanced MR strategies such as DWI and DCE-MRI can grant facts about these features, which can be used to predict therapy response[3].

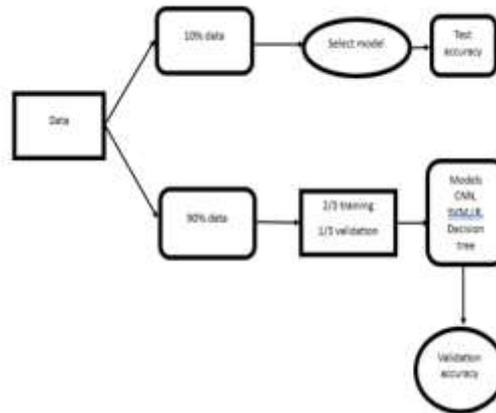


Fig.2. Testing accuracy

4. Tissue Classification for speed diagnosis:

Tissue classification is an necessary component of tender tissue tumor detection and treatment. Supervised computer studying (ML) algorithms can be used to phase and classify exclusive tissues inside multi-parametric MRI scans, which can resource in the detection, diagnosis, and cure of tender tissue sarcomas.Tissue classification may additionally contain figuring out areas of the tumor that include distinctive sorts of tissue, such as necrotic or fibrous regions, areas of hemorrhage, or areas of excessive cellularity.

These exceptional tissue sorts might also have distinctive imaging traits on MRI, and correct classification can be difficult due to the heterogeneity of tender tissue sarcomas.Supervised ML algorithms can be skilled to apprehend exclusive tissue sorts primarily based on enter facts from multi-parametric MRI scans. For example, a convolutional neural community (CNN) might also be skilled to perceive areas of excessive cellularity based totally on the obvious diffusion coefficient (ADC) map, Once tissue classification is complete, the segmented information can be used to consider post-treatment modifications in the tumor, such as modifications in size, shape, or tissue composition. This records can assist clinicians verify cure response and make selections about future remedy options.Overall, tissue classification the use of supervised ML algorithms is a promising strategy for enhancing tender tissue tumor detection and treatment. By presenting extra correct and unique records about the tumor and its response to treatment, tissue classification can assist optimize remedy techniques and enhance consequences for patients[6]

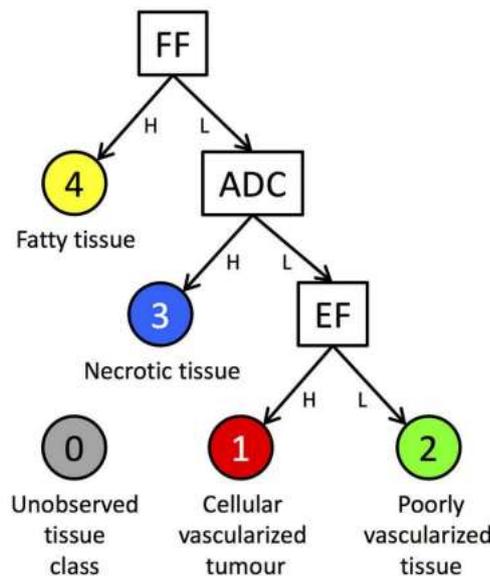


Fig. 3. Tissue classification for STT treatment detection

5. Biopsy method diagnosis for soft tissue tumor treatment detection:

Biopsy is a imperative step in the prognosis and remedy of tender. A biopsy entails taking a pattern of tissue from the suspected tumor web site for examination below a microscope to decide if most cancers cells are present. The methodology of biopsy for gentle tissue tumors may additionally rely general fitness and different factors. Some of the most frequent biopsy strategies used in the prognosis of tender tissue sarcomas include: Incisional biopsy: In this procedure, a small pattern of tissue is eliminated from the tumor the usage of a needle or scalpel. This kind of biopsy is frequently used for large tumors or these that are challenging to access. Core biopsy: In this procedure, a large pattern of tissue is eliminated the use of a large needle or distinct biopsy device. This kind of biopsy might also be used when extra tissue is wished for analysis or when the tumor is now not effortlessly accessible. Excisional biopsy: In this procedure, the complete tumor is eliminated and dispatched for examination. This kind of biopsy may additionally be used for smaller tumors or these that are effortlessly accessible. Image-guided biopsy: In this procedure, imaging strategies such as ultrasound, CT scan, or MRI are used to information the placement of the biopsy needle. This can assist make certain that the biopsy pattern is taken from the most suspicious location of the tumor. After the biopsy is performed, the tissue pattern is dispatched to a pathologist for examination beneath a microscope. The pathologist will seem for signs and symptoms of most cancers cells and decide the kind and grade of the tumor. The consequences of the biopsy will be used to decide the quality path of cure for the patient therapy choices can also consist of surgery, radiation therapy, chemotherapy, or a mixture of these approaches. Biopsy effects might also additionally assist information cure decisions, such as figuring out the extent of surgical procedure wanted or the use of focused therapies[7].

IV. PROPOSED METHODOLOY

Logistic Regression: Logistic regression is one of the most famous Machine Learning algorithms, which comes underneath the Supervised Learning technique. It is used for predicting the express based variable the use of a given set of unbiased variables. Logistic regression predicts the output of a specific based variable. Therefore the consequence have to be a express or discrete value. It can be both Yes or No, zero or 1, proper or False, etc. however as a substitute of giving the precise price as zero and 1, it offers the probabilistic values which lie between zero and 1.

Support Vector Machine: SVM however, it is frequently used in classification problems. In the SVM algorithm, we plot every information object as a factor in n-dimensional house (where n is a range of elements you have) with the price of every function being the price of a unique coordinate. Then, we operate classification by using discovering the hyper-plane that differentiates the two lessons very well.

Decision Tree: This methodology is greater typically recognized as getting to know selection tree from statistics and above tree is referred to as Classification tree as the goal is to classify passenger as survived or died. Regression timber are represented in the identical manner, simply they predict non-stop values like fee of a house. So, what is definitely going on in the background? Growing a tree entails determining on which elements to pick out and what stipulations to use for splitting, alongside with understanding when to stop. As a tree typically grows arbitrarily, you will want to trim it down for it to appear beautiful. Let's begin with a frequent method used for splitting.

Convolutional Neural Network:

Convolutional operation:

The first constructing block in our format of assault is convolution operation. In this step, we will contact on function detectors, which essentially serve as the neural network's filters. We will additionally talk about function maps, studying the parameters of such maps, how patterns are detected, the layers of detection, and how the findings are mapped out.

Step 1: Relu Layer

The 2d phase of this step will contain the Rectified Linear Unit or ReLU. We will cowl ReLU layers and discover how linearity features in the context of Convolutional Neural Networks. Not fundamental for appreciation CNN's, however there may be no damage in a speedy lesson to enhance your skills.

Step 2: Pooling Layer

In this part, we will cowl pooling and will get to recognize precisely how it typically works. Our nexus here, however, will be a unique kind of pooling; max pooling. We'll cowl a number approaches, though, inclusive of suggest (or sum) pooling. This phase will cease with a demonstration made the use of a visible interactive device that will truly kind the entire thinking out for you.

Step 3: Flattening

This will be a short breakdown of the knocking down system and how we cross from pooled to flattened layers when working with Convolutional Neural Networks.

Step 4: Total connection

In this part, the whole lot that we included all through the area will be merged together. By mastering this, you will get to envision a fuller photograph of how Convolutional Neural Networks function and how the "neurons" that are sooner or later produced research the classification of images.

V. Results and Discussions

Treatment determination for soft tissue tumors by automated diagnosis includes the techniques Logistic regression, Support Vector Machine, Decision tree, Convolutional neural Network Table 1.

Soft tissue tumor techniques and its accuracy

S. No	Techniques Used	Advantages	Disadvantages	Future Directions	Accuracy
1.	Logistic regression[1].	1)Easy to interpret: Logistic regression produces coefficients that can be without problems interpreted, making it convenient to speak findings to clinicians. 2)Can cope with small pattern sizes: Logistic regression can be used even with small pattern sizes, which can be useful when working with uncommon illnesses or confined data.	Lack of potential to take care of lacking data: Logistic regression requires whole information for all predictor variables, and can't cope with lacking records well.	Future lookup can center of attention on growing logistic regression fashions that can efficaciously combine more than one records sources to enhance the accuracy of prognosis and cure planning.	86.92%
2.	Support vector machine [3].	Robustness: SVMs are strong to outliers and noise in the data, which is necessary in scientific records analysis.	Sensitivity to hyperparameters: SVMs require cautious choice of hyperparameters such as the kernel characteristic and regularization parameter, which can be difficult in practice.	Real-time prediction: Soft tissue tumor therapy detection can future lookup can center of attention on growing SVM-based fashions that can make real-time predictions based totally on streaming facts from affected person monitoring systems.	67.30%
3.	MR imaging [3].	Non-invasive: MRI is a non-invasive imaging approach that does no longer contain radiation, making it a safer alternative for patients.	Cost: MRI is a incredibly high priced imaging modality in contrast to different imaging techniques, such as X-ray and ultrasound.	Artificial talent and computing device learning: Artificial talent and computing device getting to know strategies can be used to analyze MRI photos and enhance the accuracy of gentle tissue tumor detection.	87.7%
4.	Biopsy [7]	Accuracy: Biopsy is a relatively correct technique and can grant specified data about the tumor's traits and behavior.	Risks and complications: Biopsy tactics can elevate dangers and complications, such as bleeding, infection, and harm to surrounding tissues	Liquid biopsy: Liquid biopsy is a non-invasive biopsy approach that involves examining tumor cells and DNA from a patient's blood or different physique fluids.	88.5%
5.	Convolutional Neural Network (CNN)[6]	High accuracy: CNNs can acquire excessive accuracy in detecting and classifying smooth tissue tumors, specially when skilled on giant datasets.	Data requirements:CNNs require giant quantities of labeled scientific pics for training, which can be tough and time-consuming to acquire.	Transfer learning: Transfer mastering is a approach that includes the use of pre-trained CNN fashions to enhance the accuracy of smooth tissue tumor detection.	88.17%

6.	Decision Tree[6]	Can deal with lacking data: Decision timber can cope with lacking records and can nevertheless grant correct predictions even if some information factors are missing.	Overfitting: Decision timber are inclined to overfitting, which happens when the algorithm matches the education records too intently and fails to generalize to new data.	Ensemble methods: Ensemble methods, such as random forests and boosting, can enhance the overall performance of selection bushes via combining a couple of choice timber into a single model.	90.2%
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VI. Conclusion

High precision calculation enriched through ML algorithm can advantage purposes in various disciplines, together with the scientific field. These equipment have made it feasible to enhance the overall performance of computer-aided diagnostic structures considerably in current years, and their integration continues to furnish a project for cutting-edge fitness institutions. In this we developed a sturdy and sensible model, beginning from information amassed from the health center lets in automated predictive classification of Soft Tissue Tumors.

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