Computerized Tomography Images Processing using Artificial Intelligence Techniques

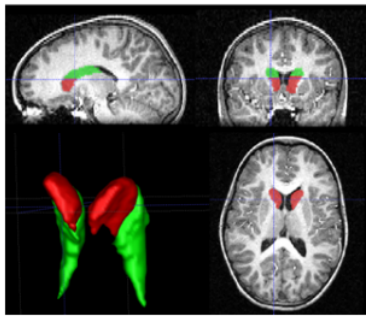
Shirley Chuquín[1], Erick Cuenca[1]

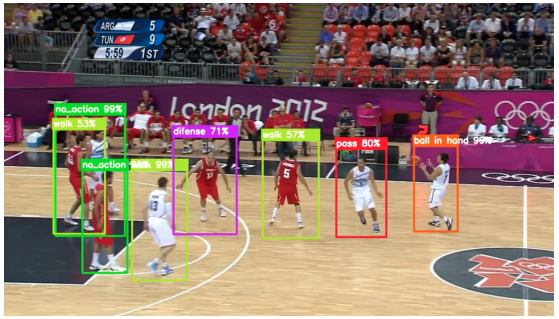
[1] Yachay Tech University

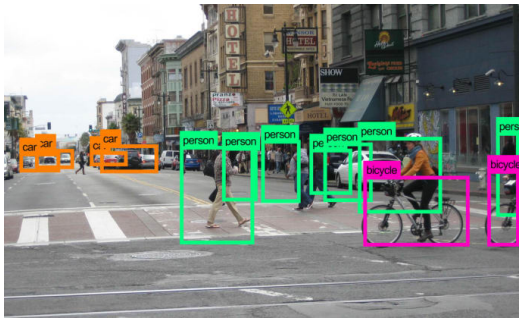
14/06/2021

Study of Images

- Image analyses are vital in medicine, agriculture, sports, and object recognition.







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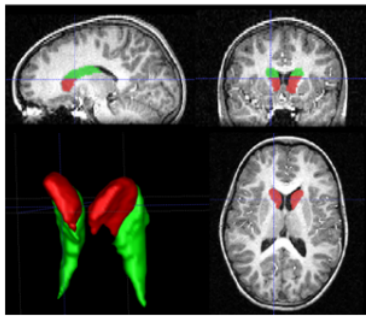

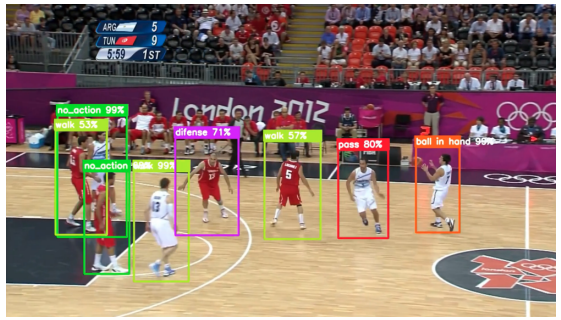

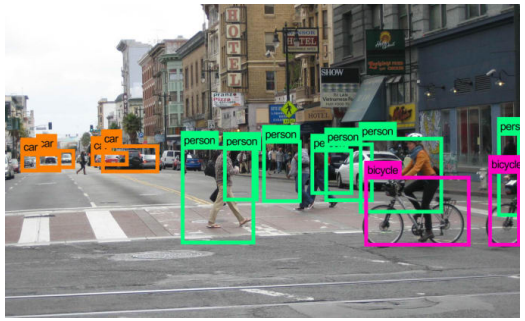

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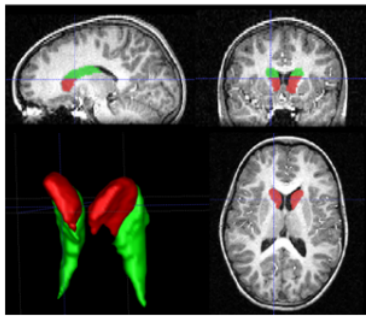

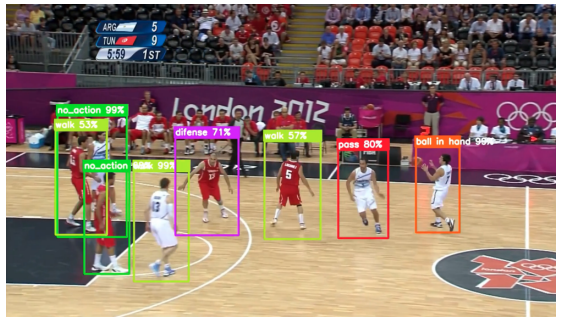

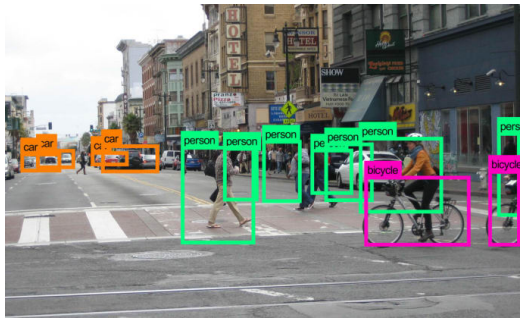

- In the medical domain, images reveal their importance to improve the processes to treat patients.
- There is extensive research to contribute to medicine by segmentation and identifying areas of interest (e.g., organs)

Study of Images

- Researches has been focuses on Computerized Tomography (CT) images to apply image processing techniques due to its essential role in detecting diseases on the liver [1], lungs [2], brain [3], skull [4], and Covid-19 disease [5].

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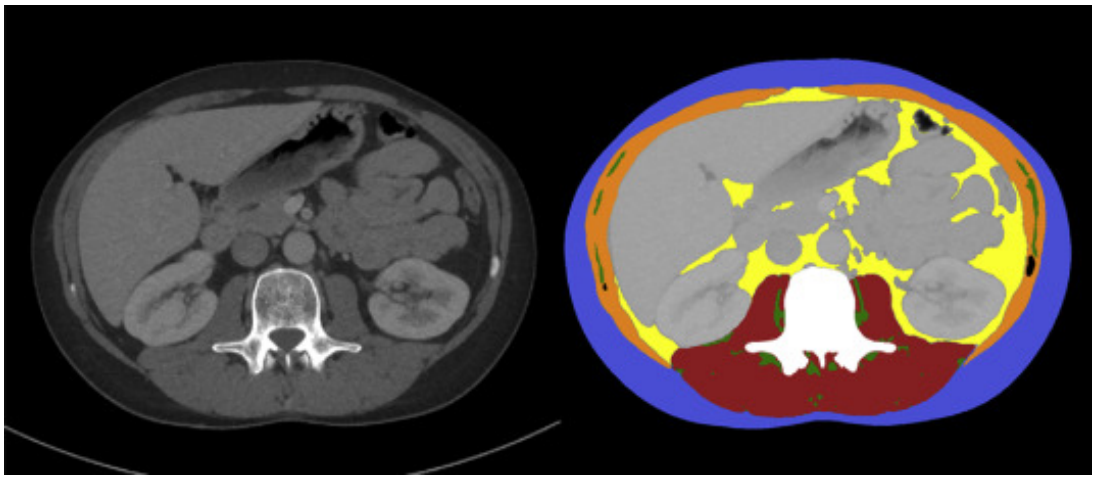
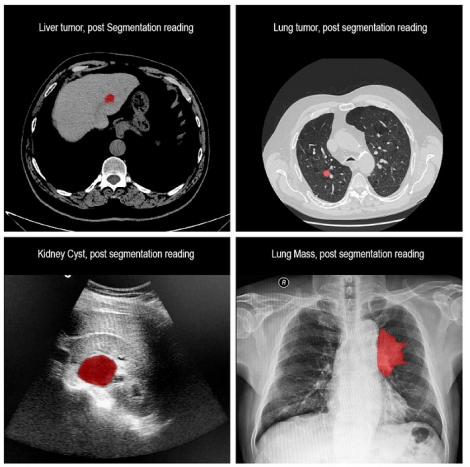
- The segmentation of CT images is a challenging task due to several factors such as the complex background, dataset size, dimensions, noise, illumination, and shadows.
- Artificial Intelligence (AI) has different ways to automated processes like Machine Learning (ML), Artificial Neural Networks (ANN), and Convolutional Neural Networks (CNN).

Objective

This work aims to present state-of-the-art image segmentation using Computed Tomography images.





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- One of the most considerable advantages is on medicine by detecting anomalies or pathologies from digital images.

Machine Learning

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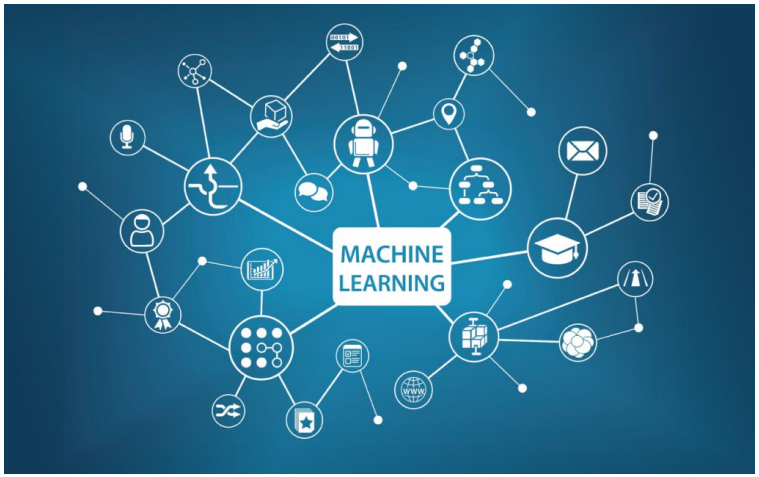

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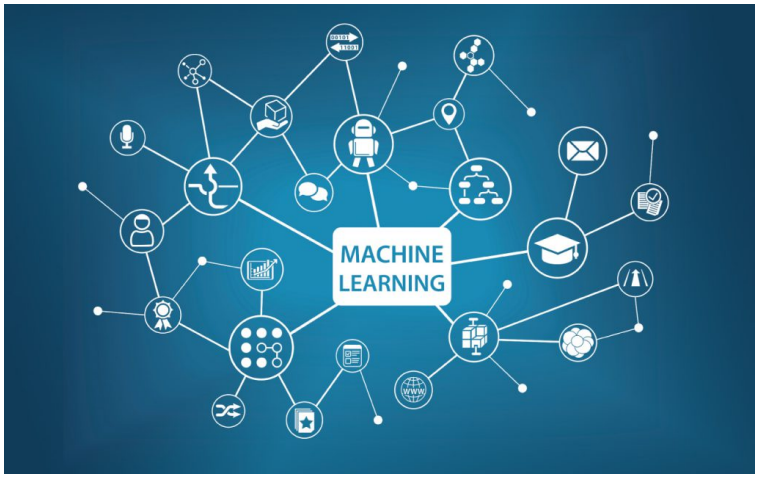

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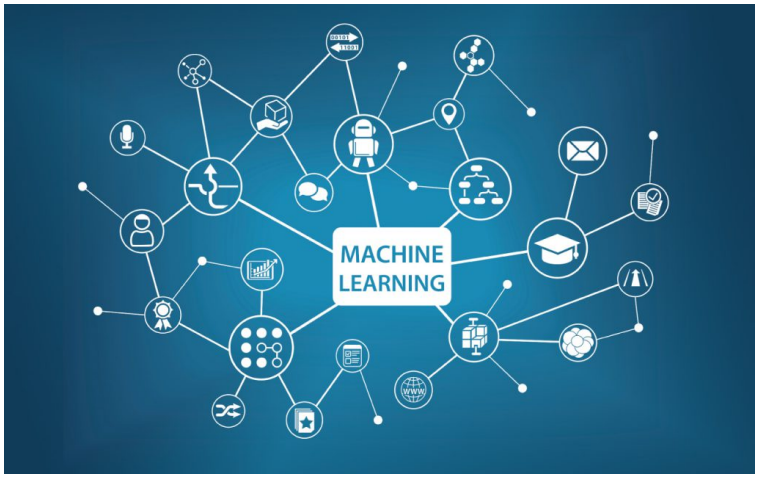

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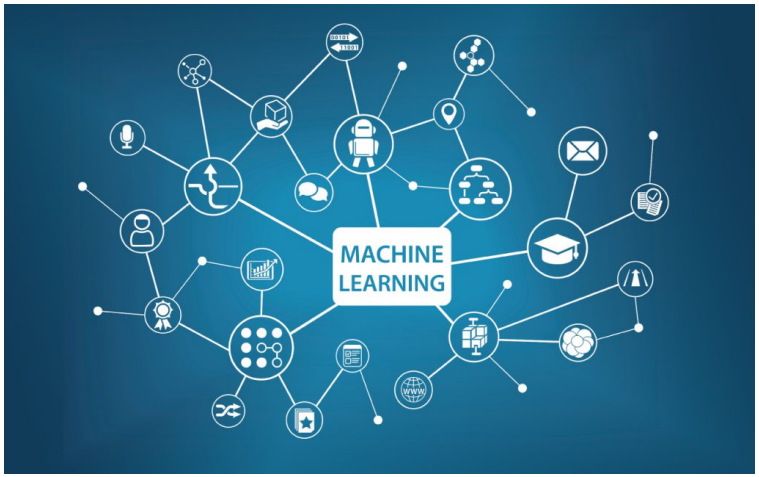
- The reinforcement algorithms use AI agents to choose the best actions to maximize a numerical reward signal [7].



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- DL has dramatically impacted research areas, from image analysis to automotive, finance, and medical industry [9].
- The impact of DL is on different studies like recognition of breast cancer [10, 11, 12, 13], extraction of brain tumor [14, 15, 3], and organ segmentation [1, 16, 9].

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- Application of CNNs are: image classification [18, 19], edge detection [20], decoding facial recognition [21, 22], and analyzing documents [23, 24].

Convolutional Neural Networks

- A CNN has three fundamental layers: a convolutional layer, a pooling layer, and a fully connected layer

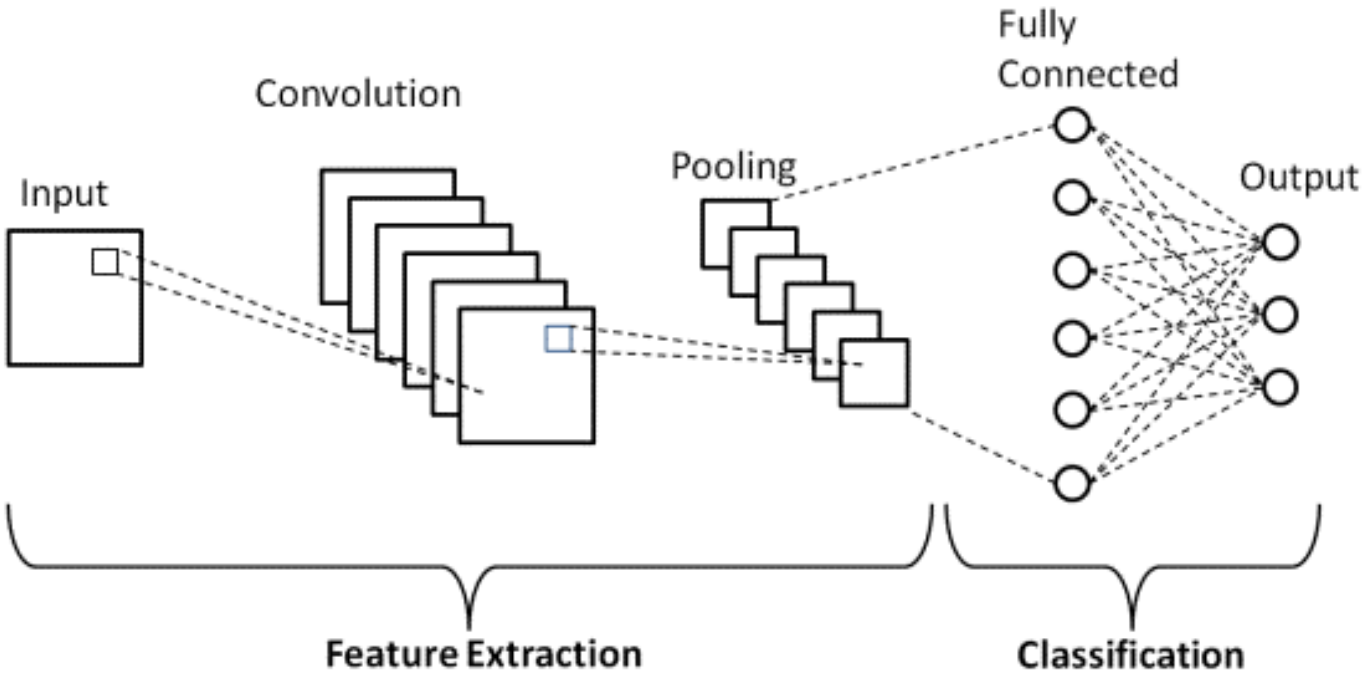
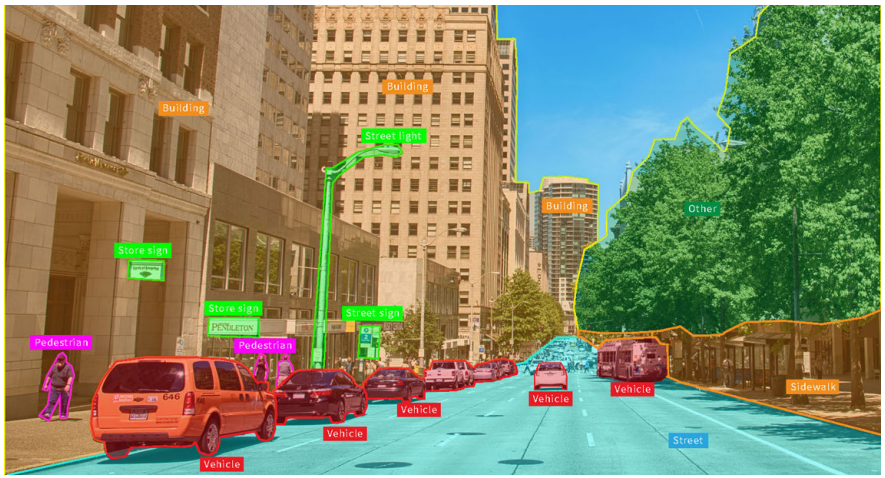


Figure 1: A CNN architecture showing the layers: convolutional, pooling, and fully connected [25].

Computer Vision

- This field aims to interpret and analyze images; however, this task is challenging due to the inverse problem of vision.



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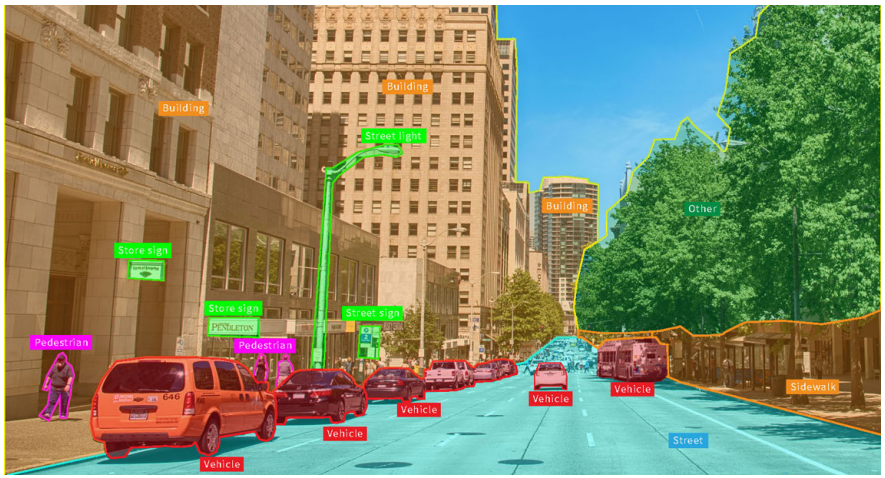
- There are many applications of computer vision such as machine inspection, retail, 3D model building, medical imaging, automotive safety, and biometrics [26].



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- Image processing applications involve the medical, agriculture, sports, and object recognition fields.

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- **Computerized Tomography image** refers to an x-ray image. It can show the skeleton, organs, and tissues as well as any abnormalities the physician is trying to identify.

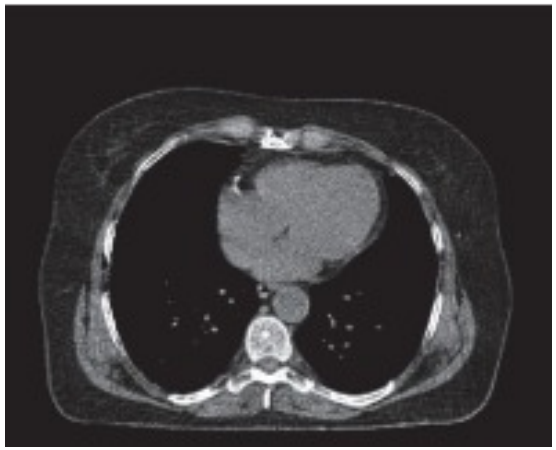

Figure 2: Example of a Computerized Tomography Image from Lung [9]

Computer Vision

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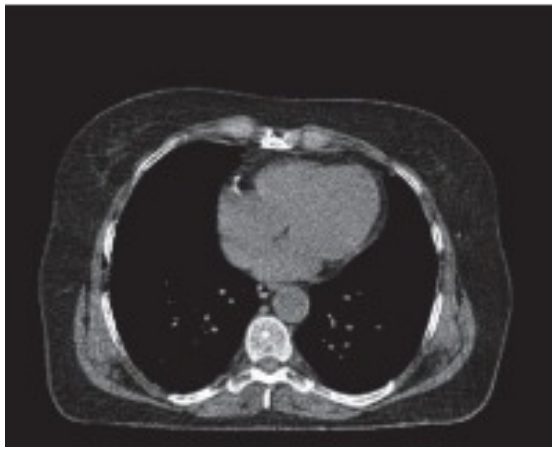
- Several challenges arise when processing images such as noise, complex background, dataset size, and shadows.



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Related Works

- Susomboom et al. [1] worked on a hybrid method to achieve a single-organ segmentation automatically. They used CT images of the liver in a DICOM format[1]. The algorithms used were the split-and-merge and region-growing.

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- Guo et al. [2] combine thresholding and the Chan-Vense algorithm to segment many types of images.

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- Wang et al. [28] propose a framework for multi-organ segmentation using Organ-Attention-Network with Reverse Connections (OAN-RCs). The OAN is a deep convolutional network that reduces the complex background
- Sakboonyara et al. [29] propose an efficient method for liver segmentation. They mention the use of U-Net and the mean-shift clustering algorithm. Also, they introduce statistical thresholding to improve the accuracy.

Related Works

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- Yan et al. [5] use a new deep convolutional neural network called COVIDSegNet to segment infected regions and the entire lung from chest CT images. The proposed network focuses on Feature Variation (FV) block and Progressive Atrous Spatial Pyramid Pooling (PASPP).

Approaches	Year	Method	Neural Networks	Deep Learning	Machine Learning	Other Methods
Yan et al. [5]	2021	Architecture with Feature Variation and Progressive Atrous Spatial Pyramid Pooling	x			
Dabiri et al. [30]	2020	Algorithm of L3		x		
Wang et al. [28]	2019	OAN - RCs and statistical fusion	x			
Sakboonyara et al. [29]	2019	U-Net and Mean-Shift Histogram	x			
Zhou et al. [16]	2019	PaNN	x			
Xu et al. [27]	2017	Membership function convolution neural network	x			
Guo et al. [2]	2015	Iterative Chan-Vese				x
Seng et al. [4]	2011	Reinforcement Learning			x	
Susomboom et al. [1]	2006	Pixel-based, split-and-merge, and region growing algorithms				x

- Image processing is crucial in many domains such as computer sciences, industry, security, and medicine.
- In recent years, the study of Computerized Tomography (CT) images reveals its importance in the medical field by helping to detect diseases like tumors, cancer, or control organs with problems.
- The automation of algorithms using advanced techniques such as Convolutional Neural Networks can improve the accuracy and performance of results.
- Previous work reveals that it is necessary to use traditional image processing techniques in the data preparation stage of the algorithms.

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Thanks!