# Deep Learning Architectures for Ultrasound Image Analysis: A Narrative Review

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## Abstract

*Background*: Ultrasound is the main screening method used to detect various anatomical structures. Unlike other imaging techniques such as Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) scanning, ultrasound is convenient, cheap, non-invasive, and can be used in real time. However, ultrasonic images present certain technical challenges, such as noise, low contrast, and overall image quality, which vary from patient to patient and physician to physician. These features led to the development of a special computer vision architecture adapted to the specific characteristics of the ultrasonic signals. *Methods*: This narrative review examined 20 articles. The inclusion criteria required research to address deep learning architectures, specifically U-Net and YOLO based models. Articles were identified using keywords such as ultrasound, deep learning, medical imaging, and were selected primary research articles, starting with the most recent. The papers were organized into four themes: image segmentation, real-time detection, spatiotemporal analysis and preprocessing techniques, with a particular focus on cardiac ultrasound. *Results*: At segmentation level, U-Net-based architectures have demonstrated their efficiency in defining anatomical structures, improving by up to 59% compared to conventional methods in data-limited scenarios. The YOLO model family has been adapted for medical tasks to identify cardiac structures and vascular pathologies with more than 80% accuracy. The transition from static images to video marks a fundamental paradigm shift, with performance improvements of up to 7% over existing models. Emerging solutions address two major challenges: lack of annotation data, addressed by knowledge distillation without real data, and image quality improved by noise reduction without clean reference images. *Conclusions*: Deep learning has notably improved ultrasound image analysis through segmentation, detection and video understanding. Ongoing challenges include limited annotation datasets, cross-device generalization and computational limitations for edge deployment. Base models and data-efficient training strategies are the most promising directions for clinical translation.

**Keywords:** Ultrasound; Computer Vision; Segmentation; Image Processing; Deep Learning.