Blockchain and federated learning-based security solutions for telesurgery system: a comprehensive review

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Abstract: The advent of telemedicine with its remote surgical procedures has effectively transformed the working of healthcare professionals. The evolution of telemedicine facilitates the remote monitoring of patients that lead to the advent of telesurgery systems, i.e. one of the most critical applications in telemedicine systems. Apart from gaining popularity, the telesurgery system may encounter security and trust issues of patients' data while communicating with the surgeon for their remote treatment. Motivated by this, we have presented a comprehensive survey on secure telesurgery systems comprising healthcare, surgical robots, traditional telesurgery systems, and the role of artificial intelligence to deal with the numerous security attacks associated with the patients' health data. Furthermore, we propose a blockchain and federated learning-based secure telesurgery system to secure the communication between patient and surgeon. The results of the proposed system are better than those of the traditional system in terms of improved latency, low data storage cost, and enhanced data offloading. Finally, we explore the research challenges and issues associated with the telesurgery system.

Key words: Telesurgery, telemedicine, artificial intelligence, blockchain, federated learning

1. Introduction

The healthcare system has evolved prominently over the years. Firstly, traditional treatment methods have evolved from simple home remedies to manual appointments with doctors where the patients had to reach the hospitals for treatment. Later, medical equipment has evolved from a simple stethoscope to various modernized surgical and monitoring equipment. However, not every healthcare center can afford to modernize or digitize their centers to provide remote services to their patients. Moreover, the critically ill patients in rural areas or military on border zones cannot reach hospitals as it is a time-consuming and expensive procedure [1]. To resolve this problem, healthcare centers gradually adopted wireless communication technologies which enable surgeons to perform their services remotely, known as telemedicine [2, 3]. Telesurgery is the most prominent telemedicine application, allowing the doctor to perform a medical surgery from a distant place with the help of wireless communication channels and surgical robots, as stated in [4]. Therefore, it reduces transportation costs, time, and resource scarcity, allowing surgeons to perform high-quality operations. Furthermore, doctors, nurses, and patients can interact together remotely to perform any surgery and treat patients accordingly [5].

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