DFI

Empowering Real-time, AI-Driven Surgical Robots with DFI High-Performance Industrial Computer EC511-ADS

Background of Story

Surgery has always been a significant concern for patients, with worries about success rates, pain, and lengthy recovery time. At the same time, the demand for greater surgical efficiency continues to rise amid limited medical resources. To address these challenges, more and more doctors and surgeons are embracing surgical robots. Powered by advanced technology, surgical robots enhance precision, minimize surgical invasiveness, improve success rates and reduce both surgery and recovery times. According to Markets & Markets, the global surgical robotics market is expected to grow from $11.1 billion in 2024 to $23.7 billion by 2029, driven by a compound annual growth rate (CAGR) of 16.5%.

Industry: **Healthcare**

Application: **Surgical Robots**

Solution: **DFI EC511-ADS Embedded Fanless PC**

Traditional Surgery vs. Robot-assisted Surgery

Traditional surgery relies heavily on the surgeon's skill and experience that have been proven effective over the years but present certain limitations. Manual methods often come with risks, such as longer operation times and higher potential for human error. In contrast, robotic surgery offers unmatched precision that manual methods cannot always achieve.

Knee replacement surgery serves as an excellent example. Before the procedure, the doctor uploads the patient's knee CT or MRI images into the system, which uses algorithms to create a 3D anatomical model. This model precisely determines the ideal size and positioning of the artificial knee joint, improving the fit between the joint and implant. The system also assists in creating an optimal surgical plan, minimizing invasiveness, avoiding high-risk areas, and selecting the safest surgical approach.

During surgery, the robotic arm performs precise and stable movements guided by optical navigation technology, which continuously tracks and adjusts the arm's position. This prevents damage to surrounding tissues and ligaments while preserving healthy cartilage. The result is a shorter surgery time, smaller incisions, reduced blood loss, and lower risks, leading to enhanced patient safety, reduced discomfort, and faster recovery.

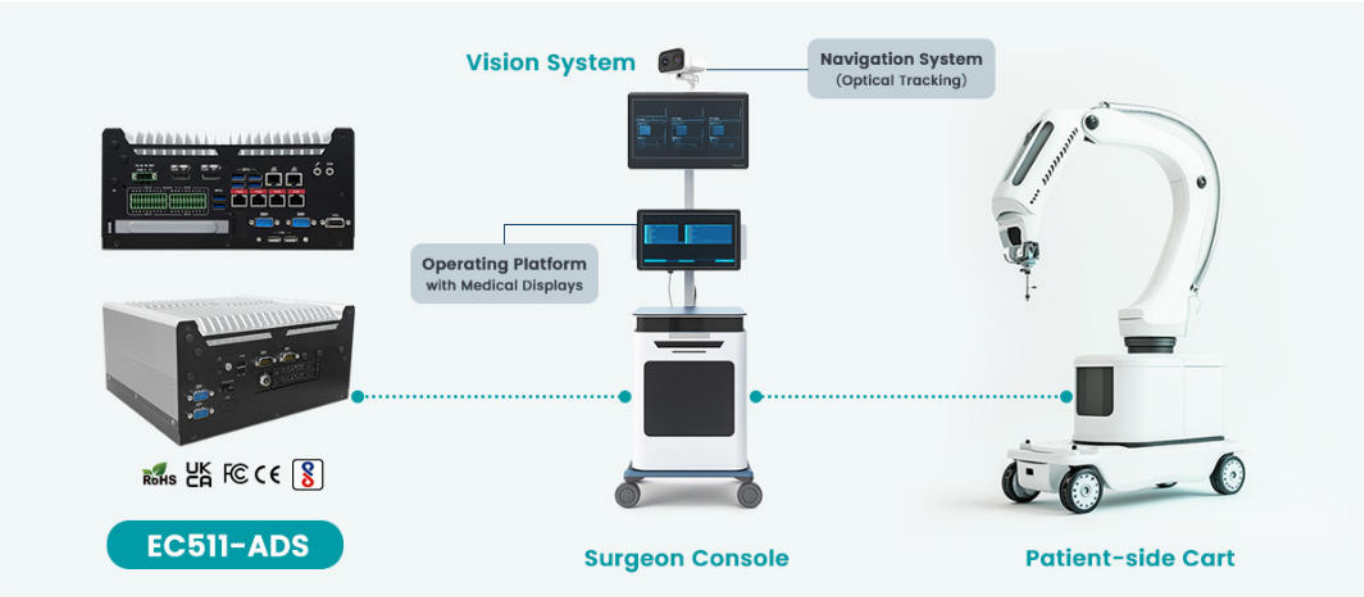
Surgical Robot System

Robotic surgery is now widely used across various specialties, including cardiac, colorectal, gynecology, head and neck, thoracic, urology, lung, knee, and general surgeries. These systems typically comprise three main components:

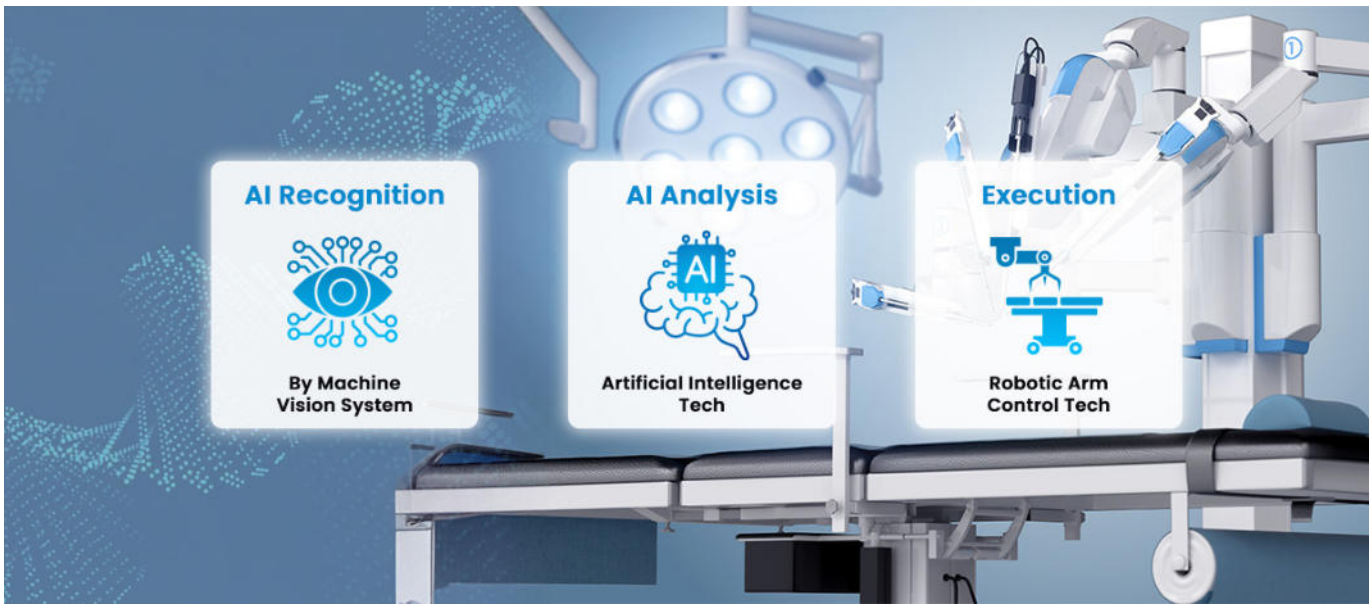
- **Patient-side Cart:** featuring robotic arms that act as extensions of the surgeon's hands, offering greater precision during surgery. It incorporates components such as sensors, actuators, motors, drivers, pumps, and proportional valves to enable smooth and accurate robotic movements.

- **Surgeon Console:** serving as the interface between the surgeon and the robotic system, featuring hand controls and a high-definition display for precise manipulation.

● **Vision System:** functioning as the surgeon's eyes, providing high-definition imaging and advanced optical tracking, delivering exceptional clarity and accuracy beyond human capability.



Seamless communication between the patient-side cart, surgeon console, and vision system in robot-assisted surgery is critical for ensuring real-time performance and surgical precision.

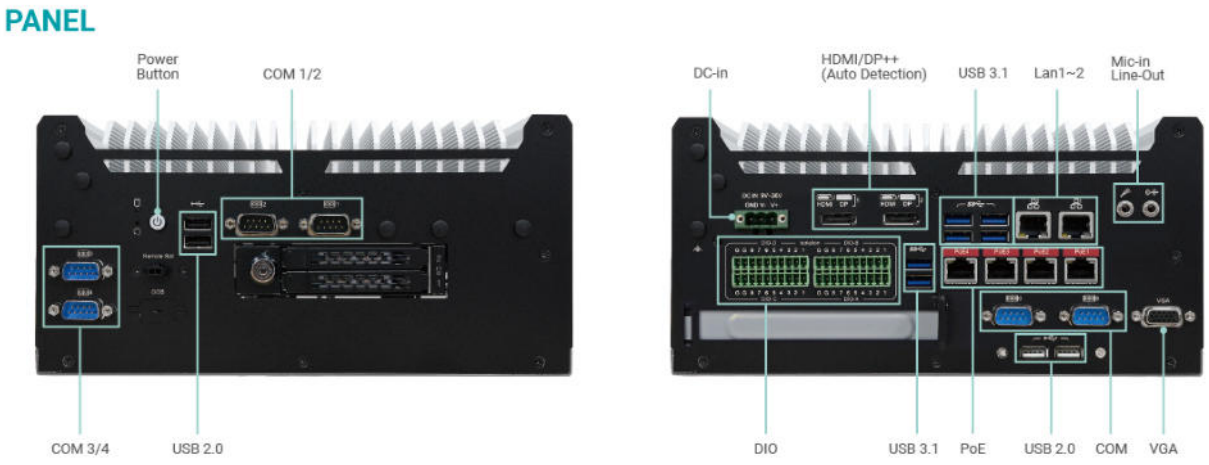


DFI, a global leader in industrial computers with over 40 years of system control expertise, was chosen by a top 3 Indian medical equipment manufacturer to develop a high-computing, reliable control system for surgical robot systems.

DFI EC511-ADS Drives Real-time AI Computing for Surgical Robots

The customer's existing control system suffered from thermal and performance issues, causing delays and disruptions. Additionally, our system needed to meet stringent Bureau of Indian Standards (BIS).

Compact, Fanless Embedded PC for Medical Edge Control - EC511-ADS



Front View

Rear View

EC51x-ADS62GA6E-Q

DFI's fanless industrial computer EC511-ADS emerged as the ideal solution for medical edge IoT controllers in surgical robot systems. With its superior edge AI compute capabilities, real-time performance, low latency, extensive connectivity and exceptional reliability, the EC511-ADS served as a powerful and efficient AI engine for complex edge computing architecture of surgical robots.

- **Real-time Performance and AI Compute**

Equipped with PCIe expansion slots, the EC511-ADS supported GPU cards to handle large-scale data processing and real-time image analysis, effortlessly fulfilling the high-precision computational demands in surgeries like 3D imaging and AI-powered image model inference. In combination with the 12th Gen Intel® Core™ processors, which feature high-performance P-cores and power-efficient E-cores that dynamically adjust to workloads, the EC511-ADS delivered robust computing power for real-time applications. From planning precise surgical approaches to recognizing, tracking and executing procedures, it ensured swift, responsive performance for seamless and efficient surgical operations.

- **Extensive Connectivity and Expansion Interfaces**

With a rich selection of I/O and expansion interfaces, the EC511-ADS enabled seamless connectivity between the vision system, surgeon console, and patient-side cart. Its excellent expandability simplified integration of critical components like servo motors, video capture cards, and frame grabber cards, ensuring rapid signal transmission and smooth system collaboration. Acting as the central control hub, the EC511-ADS empowered surgical robots and vision systems to work in perfect synchronization.

- **Efficient Heat Dissipation and Reliable Quality**

Specializing in high-performance fanless computers, DFI delivered exceptional heat dissipation designs. The fanless and efficient heat dissipation design of the EC511-ADS ensured optimal performance while maintaining low noise level, in compliance with medical certification requirements. Furthermore, DFI's production line maintains a defect rate of less than 1000 DPPM, far surpassing industry standards, and ensuring superior reliability for medical applications.

- **Exceptional Technical Support**

DFI provided timely and reliable support to the customer throughout the sales and development process. This included addressing technical challenges, partial product customization, and supporting compliance with the Bureau of Indian Standards (BIS). To ensure smooth collaboration, DFI scheduled regular in-person meetings with the client during the Proof of Concept (PoC) phase, enabling successful implementation of the surgical robot system.

Realizing AI-Driven Surgical Robots

By adopting the EC511-ADS embedded solution, our customer was able to streamline the development of their surgical robot system. The robust AI computing power, rich I/O and expansion interfaces of EC511-ADS simplified the integration process while ensuring real-time communication and operation. Its efficient heat dissipation and reliable quality prevented throttling issues, guaranteeing optimal performance during operation. In addition, with DFI's support and flexibility in partial customization, the client successfully obtained BIS certification for the EC511-ADS , ensuring their surgical robots met the stringent medical device requirements of the local market and enabling a successful product launch. In conclusion, DFI's EC511-ADS fanless industrial computer proved to be the ideal medical edge IoT controller for AI-driven, minimally invasive surgery. With outstanding computing power, real-time connectivity, and unparalleled technical support, DFI empowered its customer to overcome critical challenges and position themselves at the forefront of the surgical robotics market.