Artificial Intelligence through Surgical Robotics

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Abstract: Artificial intelligence (AI) has recently achieved considerable success in different domains including medical applications. Although current advances are expected to impact surgery, up until now AI has not been able to leverage its full potential due to several challenges that are specific to that field. Summary: This review summarizes data-driven methods and technologies needed as a prerequisite for different AI-based assistance functions in the operating room. Potential effects of AI usage in surgery will be highlighted, concluding with ongoing challenges to enabling AI for surgery.

Key Messages: AI-assisted surgery will enable data-driven decision-making via decision support systems and cognitive robotic assistance. The use of AI for workflow analysis will help provide appropriate assistance in the right context. The requirements for such assistance must be defined by surgeons in close cooperation with computer scientists and engineers. Once the existing challenges will have been solved, AI assistance has the potential to improve patient care by supporting the surgeon without replacing him or her.

INTRODUCTION

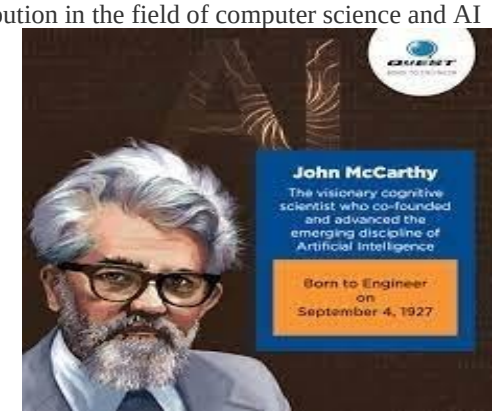
Using robots in the operating room to assist the surgeon in performing surgery—

Robotic surgery also called robot assisted surgery, allows doctors to perform many types of complex procedures with more precision, flexibility and control than is possible with conventional techniques. Robotic surgery is usually associated with minimally invasive surgery – procedures performed through tiny incisions.

The surgeon views the patient via a terminal and manipulates robotic surgical instruments via a control panel—Using robots in the operating room to assist the surgeon in performing surgery. The surgeon views the patient via a terminal and manipulates robotic surgical instruments via a control panel. Views of the organs being worked on are transmitted from tiny cameras inserted into the body. Such robots are considerably less invasive than normal operating room procedures because the instruments can be inserted into much smaller incisions in the human body. This type of "laparoscopic" surgery means less pain and less scarring, and patients recover much faster. Since the patient and surgeon are separated by an electronic console, it also enables "telesurgery",which allows the surgeon to perform the operation in a remote location.

Views of the organs being worked on are transmitted from tiny cameras inserted into the body—An endoscopy is a test to look inside your body. A long, thin tube with a small camera inside, called an endoscope, is passed into your body through a natural opening such as your mouth.

Father of AI One of the greatest innovators in the field was JOHN McCarthy, widely recognized as the father of Artificial Intelligence due to his astounding contribution in the field of computer science and AI



Why we need robotic surgery

1. **PRECISE—**In the operating room surgeons must always be precise when making incisions or performing other surgical tasks. The repetitive task are challenging. To assist surgeons the medical field is using the advancement of AI and collaborative robots in the OR.
2. **FLEXIBILITY**—This gives rise to the development of flexible surgical robots, including snake-like flexible manipulators , and soft robots.
3. **CONTROL—**Thus, AI collects data over time by watching surgeons perform. With the help of all the collected data and algorithms, AI assists surgical robots with reasoning and performance of cognitive functions like decision making, problem-solving, speech recognition and more.
4. **CAN PERFORM DELICATE AND COMPLEX PROCEDURE**—It allows doctors

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HOW AI HELPS IN ROBOTIC SURGERY

AI provides robots with adequate computer vision and motion control to better understand the environment and act accordingly. Similarly machine learning conditions the robot in such a way that with timely evolution, they learn from their own mistakes, thus preventing constant human intervention and parallel effort. It can also determine the patterns within surgical procedures to improve best practices.

Control accuracy to submillimeter precision—Accuracy is the ability of a robot to move its end effector to a desired position and orientation that has never been attained before.

To analyse scans and detect Cancerous cases—For some types of cancers , traditional open surgery may not be the best option. With robotic surgery, specially trained surgeons use robotic technology, including tiny surgical tools and a computer console, to remove a patients's cancer.

3 MAJOR COMPONENTS

It consists of three components – the surgeon's console, a surgical cart, and the vision cart. All of these components work together to allow the surgeon to view what is happening and then mimics the moments to guide the instruments.

1.SURGEON CONSOLE— It is the place where the surgeon sits. This is the area where he sees what is happening and has master control of how the instruments need to move. He can view high-definition real-time 3D images at the console.

2.SURGICAL CART—It is kept next to the patient's bed where he is being operated on. The patient cart holds the camera and the instruments that are required for the surgery.

3.VISION CART—It is the third component that is in charge of enabling the communication to take place seamlessly between all the components. The components of different surgical systems may vary depending on the particular system.

HOW ROBOTIC SURGERY WORKS?

The most widely used clinical robotic surgical system includes a camera arm and mechanical arms with surgical instruments attached to them. The surgeon controls the arms while seated at a computer console near the operating table. The console gives the surgeon a high-definition, magnified, 3D view of the surgical site. 1. MAKE TINY INCISION -- During a robotic hysterectomy, your surgeon makes five small incisions in your abdomen to provide access for surgical tools. Through these incisions, your surgeon detaches your uterus and possibly your ovaries and fallopian tubes from surrounding tissues.

2. INSERT--To operate using the Robotic system, your surgeon makes tiny incisions in your body and inserts miniaturized instruments and a highdefinition three-dimensional camera, and sometimes skin incisions are not required at all. Then, from a nearby console, your surgeon manipulates those instruments to perform the operation.

3. MINIATURIZED INSTRUMENT--These are miniaturized endoscopes that can be used in many diagnostic tests, surgeries or for drug delivery.

4. SURGEON MANIPULATE INSTRUMENT TO PERFORM OPERATION--The most widely used clinical robotic surgical system includes a camera arm and mechanical arms with surgical instruments attached to them. The surgeon controls the arms while seated at a computer console near the operating table. The console gives the surgeon a high-definition, magnified, 3D view of the surgical site.

BENEFITS OF ROBOTIC SURGERY

1. Greater range of motion and dexterity
2. Highly-magnified , high – resolution image 3. Better access to the area behind operated on.
4. Shorter hospital stay
5. Less risk of infection
6. Less blood loss and fewer blood transfusions
7. Less pain
8. Faster recovery
9. Quicker return to daily routine

DISADVANTAGES

- Large initial capital investment
- Cost of Maintenance
- Training
- The loss of touch
- Size of the robot
- The need of smaller instruments

FUTURE OF ROBOTIC SURGERY

With increases in demand, funding, and research, the robotic surgery market is projected to reach $14.4 billion by 2026. The future of robotic surgery is exciting and we're proud to have our enabling motion tracking systems be a part of this medical technology that enhances patient care and saves lives.

1. ANESTHESIOLOGIST--Monitor and control the patient's vital life functions, including heart rate and rhythm, breathing, blood pressure**,** body temperature and body fluid balance. Control the patient's pain and level of consciousness to make conditions ideal for a safe and successful surgery.

2. HEART SURGERY--Robotic cardiac surgery is heart surgery done through very small cuts in the chest. With the use of tiny instruments and robot-controlled tools, surgeons are able to do heart surgery in a way that is much less invasive than open-heart surgery.

3. HEAD AND NECK SURGERY--Robotic head and neck surgery applies minimally invasive principles to unique anatomy and natural orifices for surgical access. Expanding from a tradition of minimally invasive endoscopic otolaryngology procedures, surgical robotics has transformed head and neck surgery.

Conclusion

Robots are finding new ways to get inside the patient, rather than the standard large incision.Surgical robotics systems mark the beginning of a potentially huge wave of surgical applications for robotic technology. With the emergence of the first completely robotic surgery system , we are crossing the threshold into an amazing new future.

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