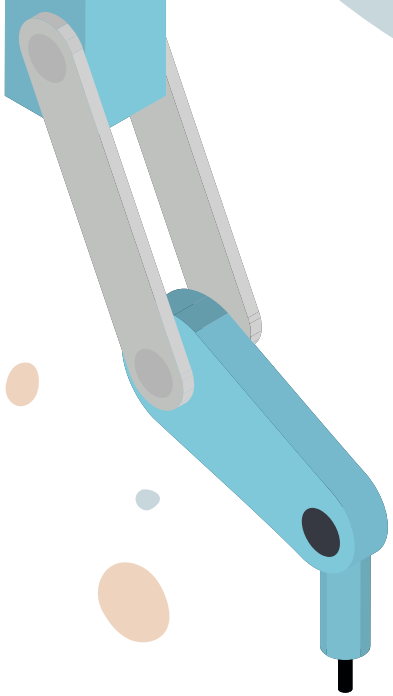


The Rise of the Robotics Scalpel

A Sci-Fi Reality

Presented by: Komal Vachhani

Hey, nice to meet you!

I'm Komal!

I'm an intern on the Motion Platform Team!

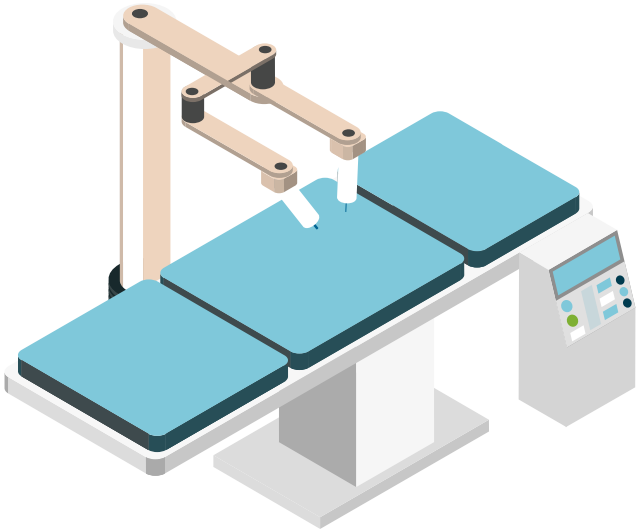
I'm a second year Computer Engineering student @ The University of Waterloo

Recently started a URA at the Vision and Image Processing Lab @ The University of Waterloo

01

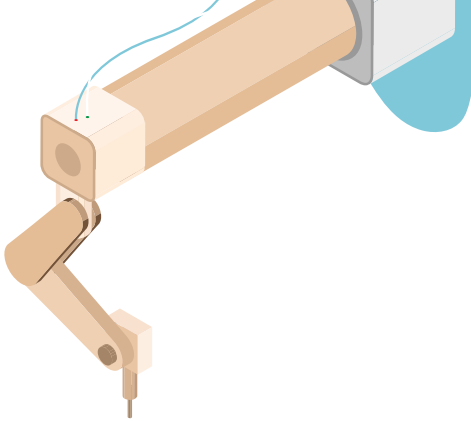
Introduction

Let’s talk about surgery.



What is surgery?

Surgery is a medical specialty that involves using invasive techniques to diagnose and treat diseases, injuries, and deformities. The goal of surgery is to repair or remove damaged or diseased tissue, organs, or structures in the body.



So why Robotics?

Enhanced Precision

Increased Flexibility

Improved Control

Less Invasive

Reduced Risk of Infection

02

Overview of History

What have surgical robots been able to do so far?

TIMELINE

1985

The PUMA 560 was used to place a needle for a brain biopsy using CT guidance

1988

The PROBOT was developed at Imperial College London

1992

the ROBODOC from Integrated Surgical Systems was introduced for hip replacement

2006

The first “unmanned” surgery took place in Italy

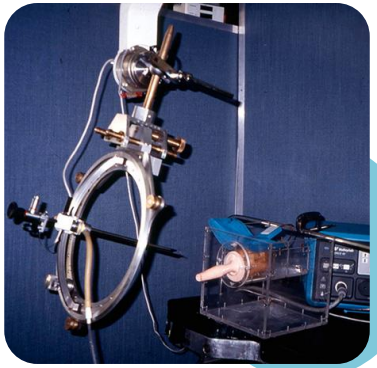
2010

THEY DID SURGERY ON A GRAPE

The First Few Surgical Bots to Ever Exist

PUMA 560

Used for brain biopsies to access hard-to-reach areas of the brain



PROBOT

Used to help do surgery on the prostate through the urethra while using a computer to control the machine

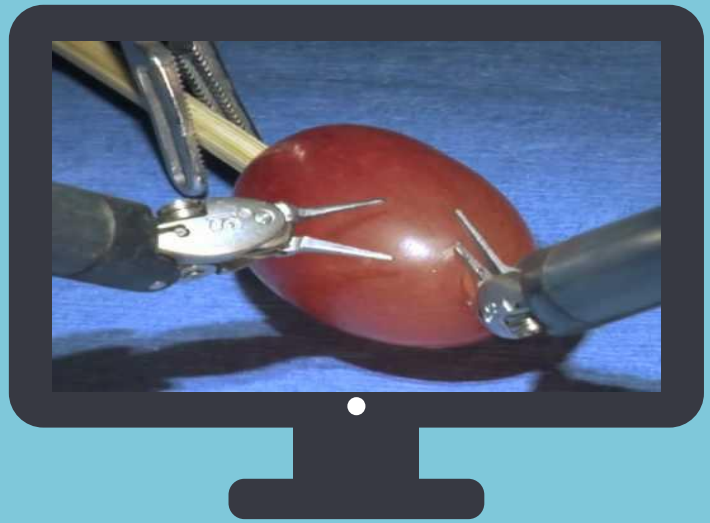
ROBODOC

Used in hip surgery to create a cavity around the hip socket for a replacement to go in

THEY DID SURGERY ON A GRAPE*

IT'S TRUE! It was using the Da Vinci Surgical System in 2010!

* Know Your Meme



More Recent Developments

Smart Tissue Autonomous Robot (STAR)

- Utilizes AI to “autonomously” perform anastomosis
- 50 minutes with the robot vs. 8 minutes with a surgeon
- Uses advanced computer vision and a CNN-based landmark detection algorithm to generate suture plans

Read more HERE!

Popular surgical robots that have been developed

1. Da Vinci Surgical system by Intuitive Surgical
2. ZEUS Robotic Surgical System
3. AESOP Robotic System

03

About

How does the Da Vinci Surgical System work?

Classification of Systems

Supervisory-Controlled systems

Robot carries out high-level instructions under surgeons supervision.

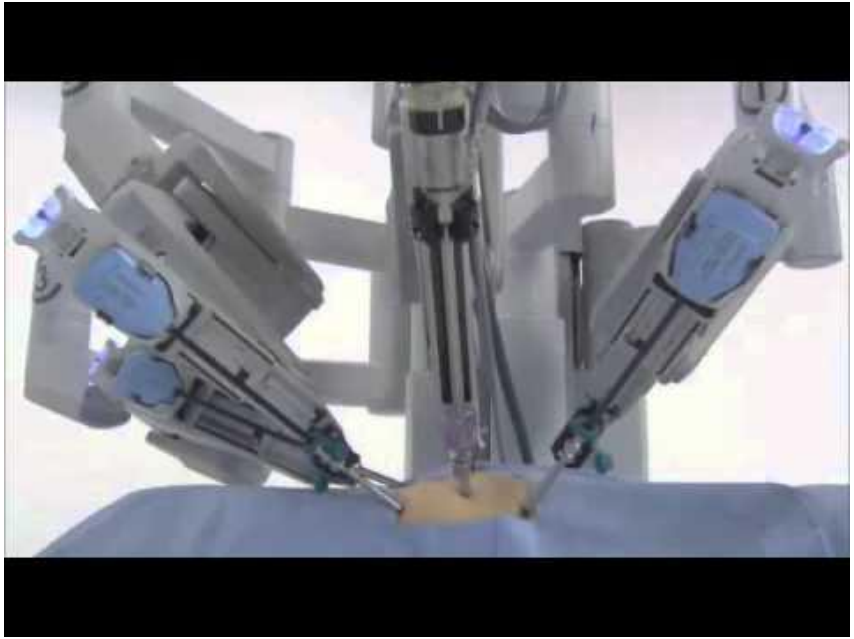
Telesurgical Systems

Surgeons are able to perform procedures remotely.

Shared-Control Systems

Surgeon and robot work in harmony.

Da Vinci Surgical System



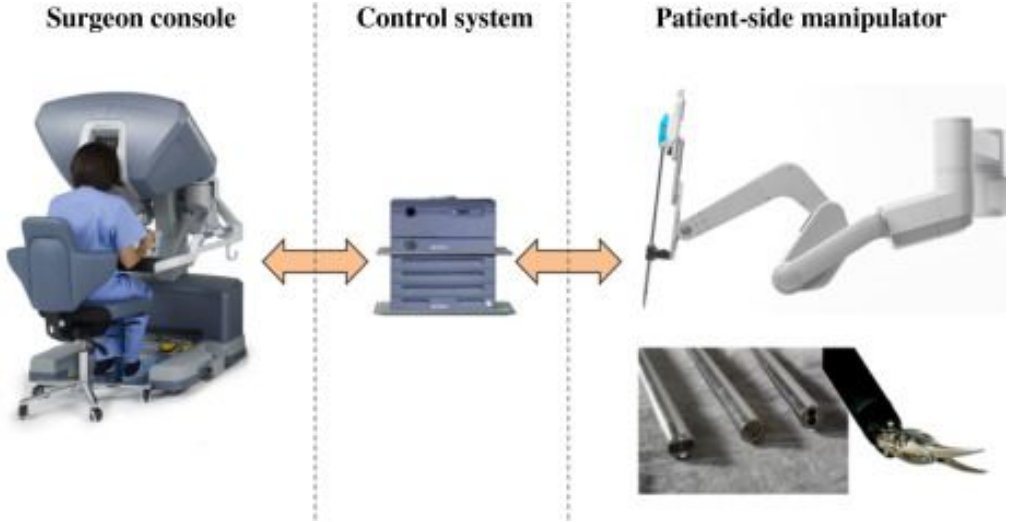
Components

SURGEON CONSOLE

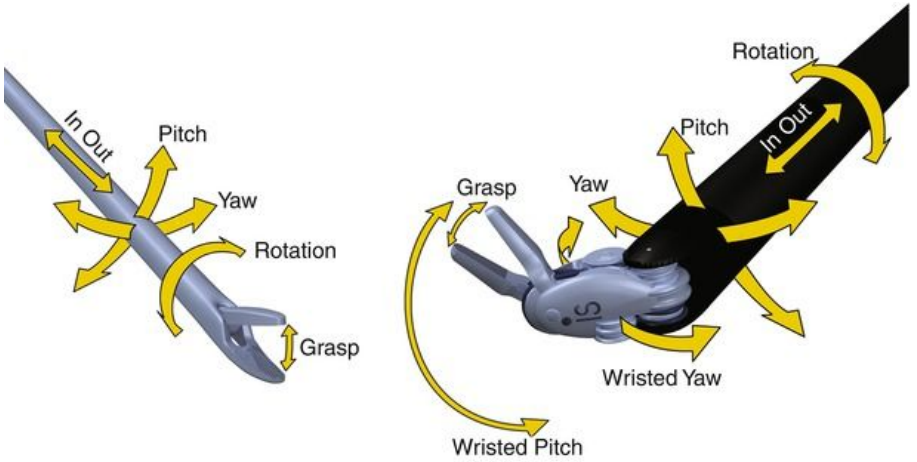
PATIENT CART

VISION CART

Architecture



End Effector



Specs

Height: 175.3 cm
Length: 127 cm
Width: 91.5 cm
Weight: 544.3 kg
Cost: Depends on configuration, but around $1.2 million

Sensors: Optical encoders, Hall sensors, magnetic encoders, infrared sensors
Actuators: DC motors
Power: 120 V AC with battery backup
Computing: Combination of various DSPs, microcontrollers, and FPGAs
Software: Custom OS/control software
Degrees of Freedom: 7

04

Impact

How do we know it’s needed?

Patient Medical History

Bridget Cairns

- Operated on by the **Da Vinci Surgical Robot**
- **Location:** Humber River Hospital

Early 2016

DIAGNOSIS

Bridget was diagnosed with kidney cancer.

Mid-December 2016

TREATMENT

Bridget underwent her kidney cancer procedure.

Mid-December 2016 + 2 days

POST-OP

Bridget wasn't on any painkillers & went home.

Other Applications

Cardiac surgeries: Mitral valve repair, Coronary artery bypass.

Colorectal surgeries: Crohn’s disease, Colorectal cancer, Diverticulitis, Ulcerative colitis, Abscesses, blockages and ruptures of the large intestine, Rectal prolapse.

General surgeries (abdomen and digestive tract): Liver conditions, Stomach conditions, Pancreas conditions, Conditions of the intestines, Gallbladder conditions

Gynecology surgeries: Hysterectomy, Endometriosis, Pelvic pain, Abnormal bleeding, Fibroids, Pelvic organ prolapse, Incontinence procedures, Incompetent Cervix, Cancers

Urology surgeries: Enlarged prostate, Cancers, Benign tumors.

+ many others

05

Challenges and Limitations

We may always need real surgeons after all...

Limitations

- Patient trust
- Cost
- Learning curve
- Technical issues
- Limited haptic feedback
- Limited adaptability
- High maintenance costs
- Limited Availability

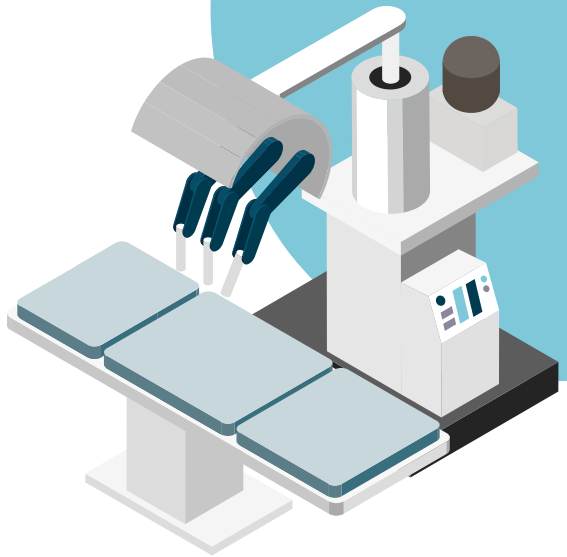
06

Conclusion

My thoughts. Your thoughts. Let’s talk.

CONCLUSIONS

Surgical robots are an exciting development in the medical field that is changing the way surgeries are performed. With advanced technology, these robots offer many advantages over traditional surgical methods, including greater precision, less pain, and faster recovery times. While there are challenges and limitations, the potential benefits of surgical robots make them a valuable tool for surgeons in providing the best possible care for their patients.



Thank You!