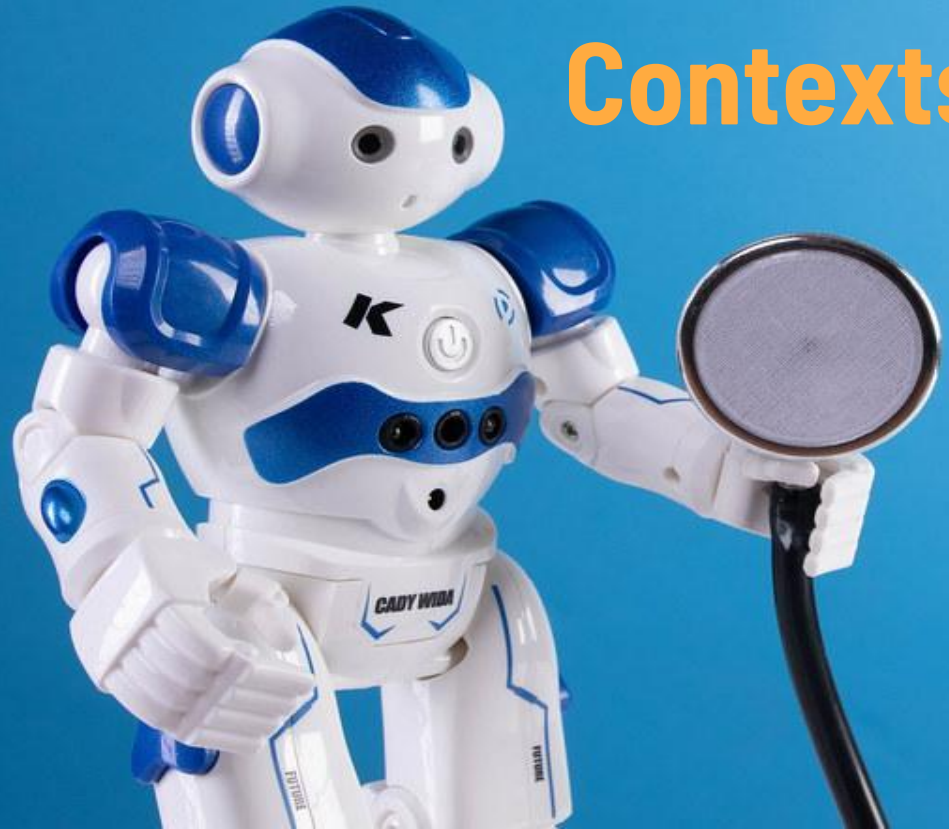
Robots in Non-Manufacturing Contexts



ME 395 Mini-Lecture

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Healthcare: Da Vinci Robot

A Robotic Surgical system

What's the Da Vinci System?

A robotic surgical system developed by Intuitive Surgical that translates a well-trained surgeon's hand movement into reality to operate on a patient.

3 Parts to a Da Vinci System:

1) **Patient Cart**
1) **Surgeon Console**
1) **Vision Cart**

Patient Cart

Holds the instruments and sits above the patient

Surgeon Console

Provides 3D visual as well as instrument controlled by the surgeon

Vision Cart

Provides screen for visualization of the procedure, hub for power generation, image processing, and information systems.

Operating From console

1. Adjustable:

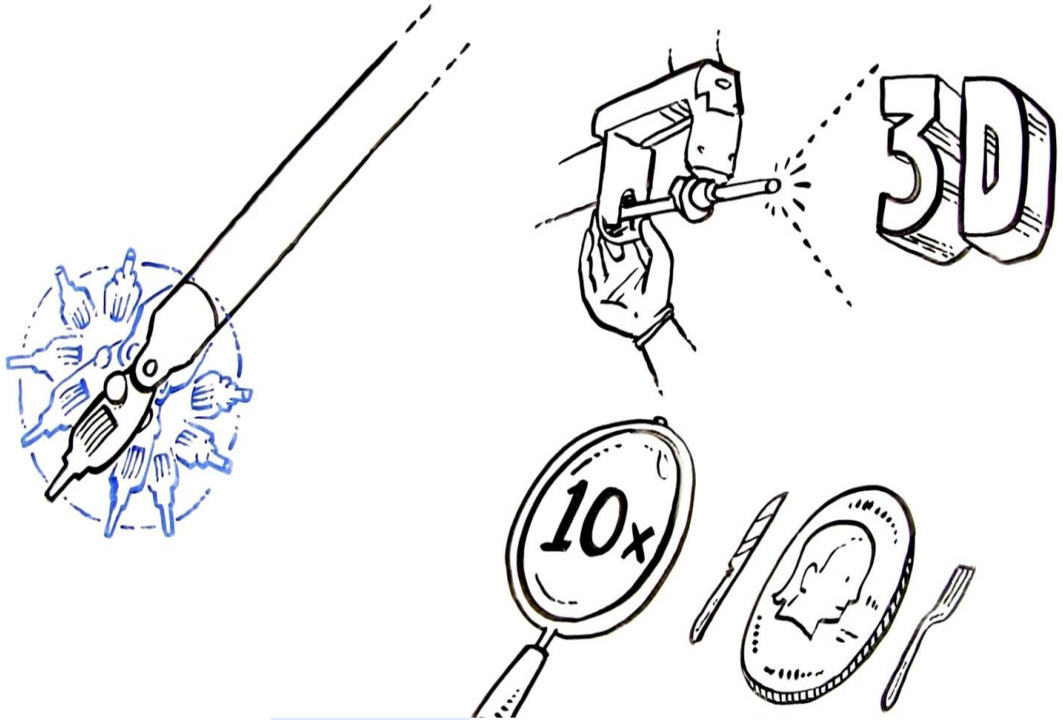
- adjusts in multiple ways to help surgeon get a good fit for the height and reach

1. Customizable :

- All settings can be customized
- Surgeon has total control of the wristed instrument on each of four arm

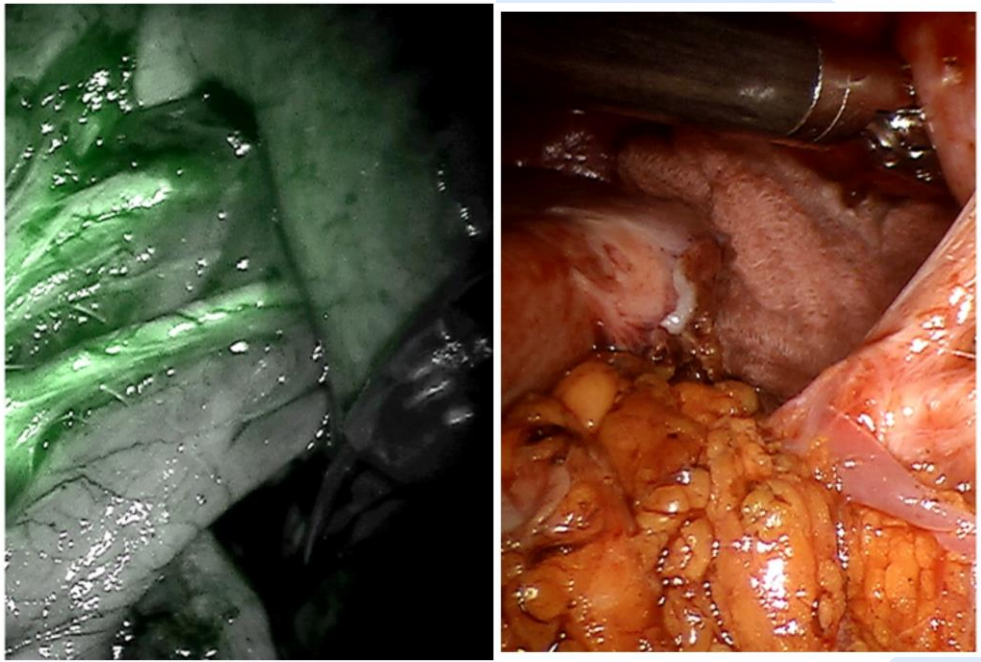
Camera Resolution

The high-definition camera can provides **10 times** resolution images In **3D**. Giving the surgeon more clear and accurate vision than bare eyes.

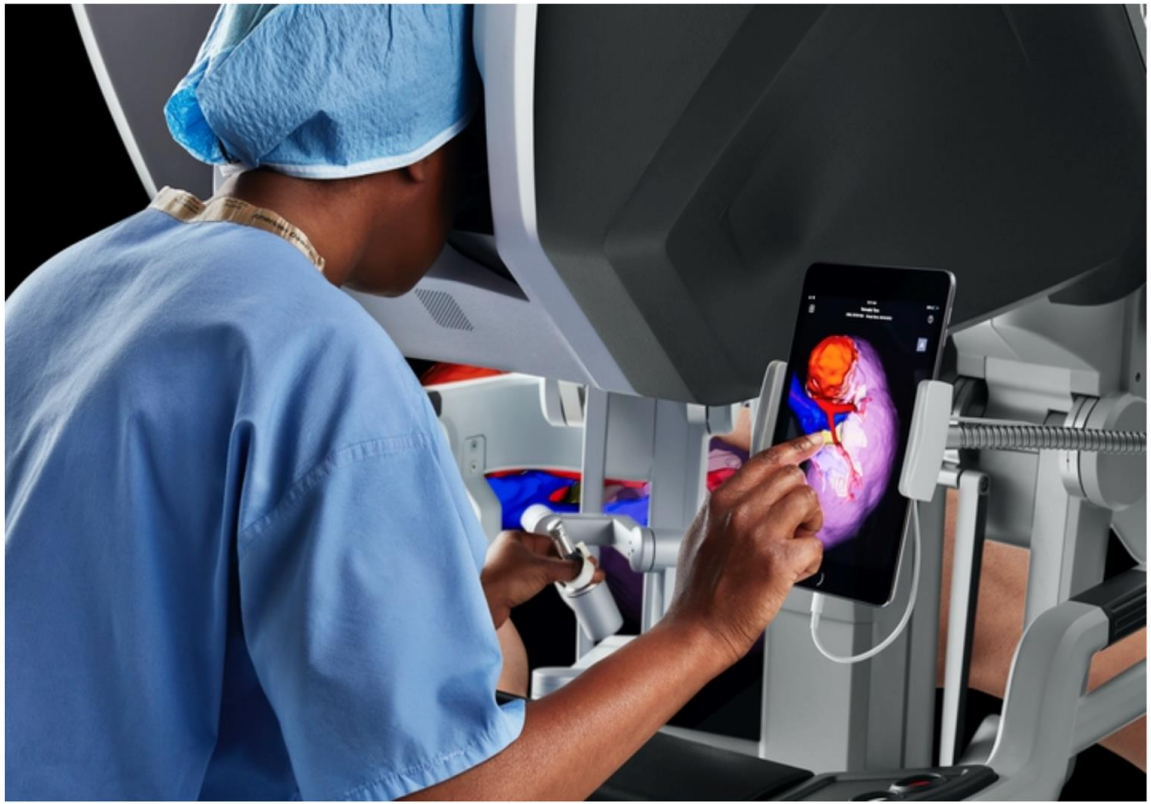


Firefly fluorescence Images

The Da Vinci camera can trigger injected dye to fluoresce, giving enhanced visuals



Compatible with other visual system



Using CT scans, a segmented 3D model of anatomy can be created to help prepare for surgery.

During the procedure, the surgeon can view the model at the Da Vinci Surgeon Console and manipulate it on any mobile device.

What happens during robotic surgery

01

Placing ports (thin tubes)

The surgeon makes one or more small incisions (only finger tip size), and places the ports

02

Visualization

A long thin camera is placed through one of the ports, which provides high-definition images in 3D to console.

03

Operation

Surgical instruments are placed through the other ports that allows the surgeon to do the operation through robot arm at a console.

04

Changing instrument

For different surgeries, there are specific steps in order, which need various instruments. So, an assistant should change the instruments if needed

Pros & Cons

Pros

1. Minimally invasive
2. Less pain/scarring
3. Lower risk of complications
4. Shorter hospital stays
5. More dexterity for surgeon
6. Lower fatigue for surgeon

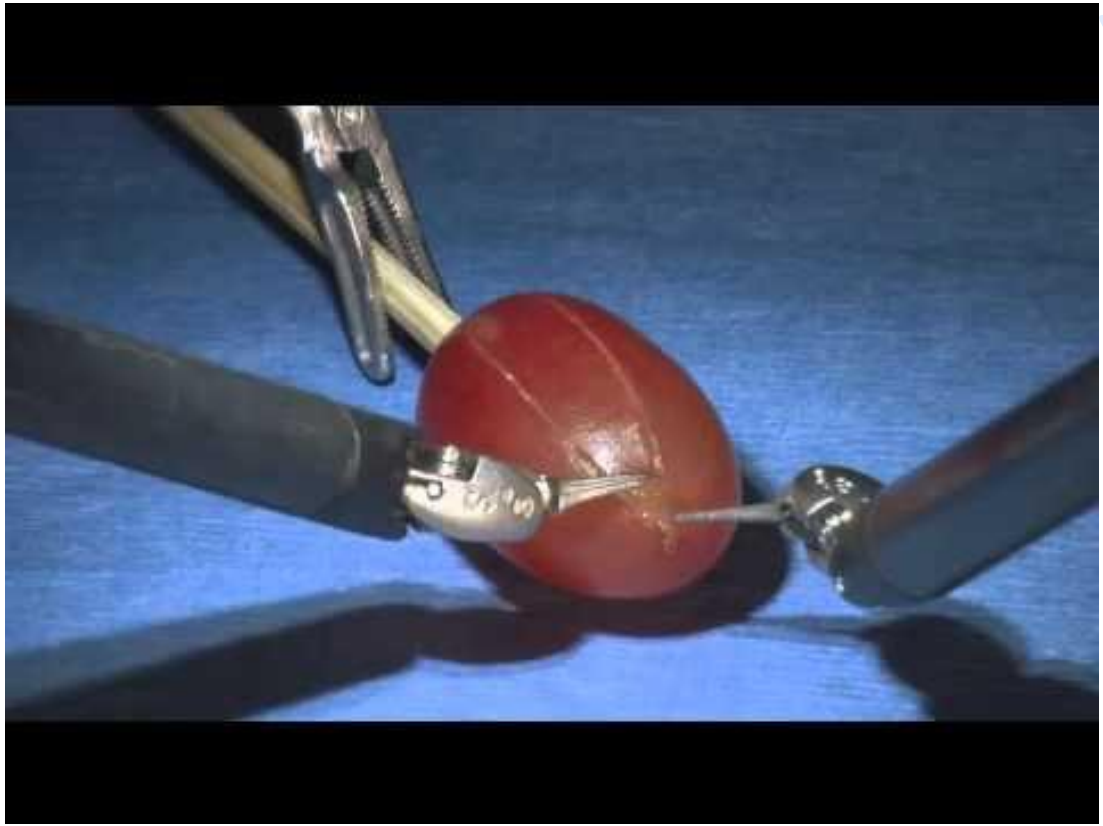
Lower risk/ higher operability

Cons

1. No standard tactile feedback for Surgeon (yet)
2. Higher costs
3. Risk of malfunctioning
4. Massive learning curve on the equipment

Applicability

It does a pretty grape job...



Agriculture: Agrobot

Robotic high-tech farming equipment

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Agrobot

What is the Agrobot?

The first pre-commercial robotic harvester for gently harvesting strawberries.

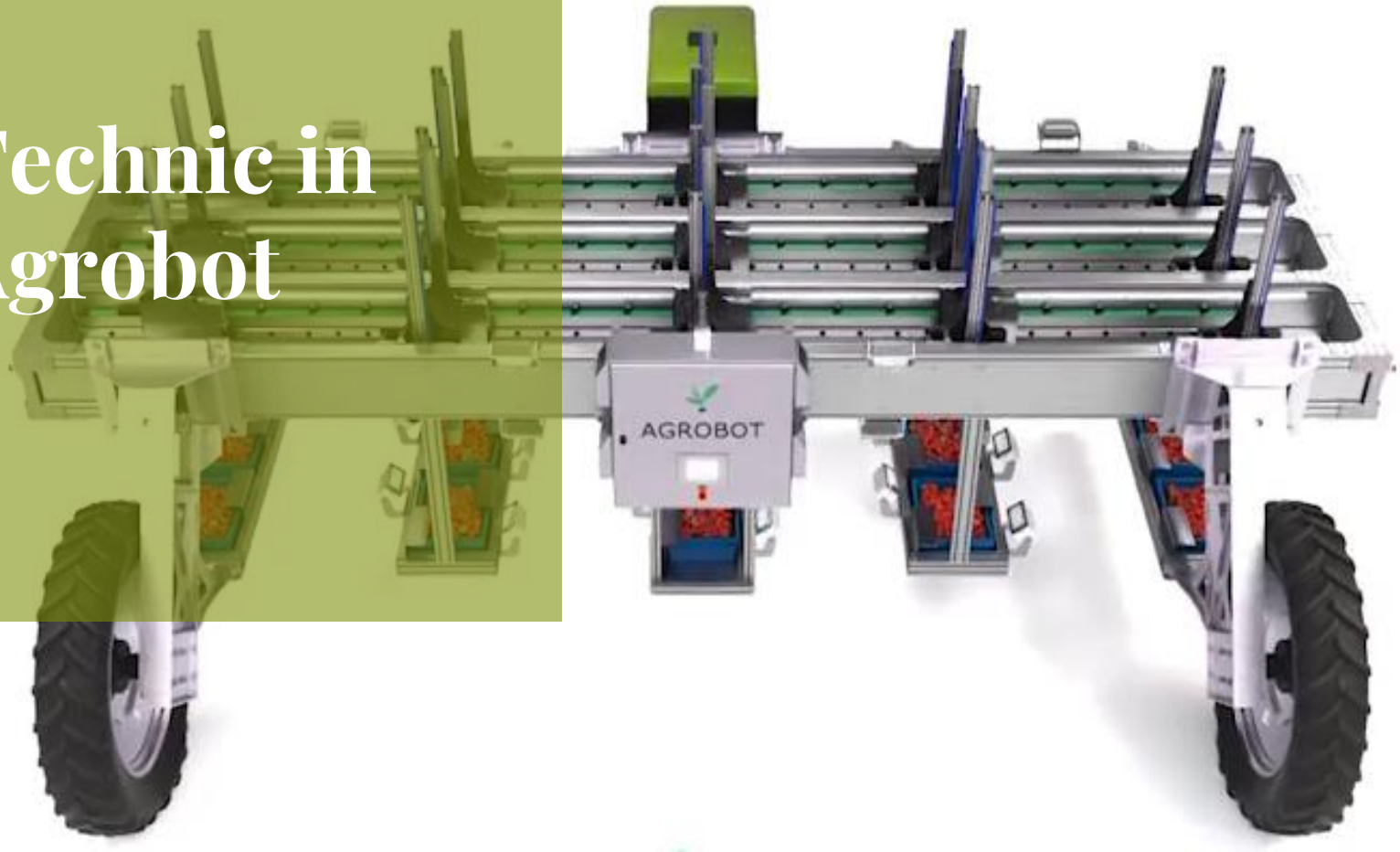
Characteristics

- Adaptable Configuration
  - Up to 24 independent robotic arms
  - Flexible platform
- High Reliability
  - Robustly operates with a high degree of precision
  - Self-reliant decentralized arms

Characteristics [cont.]

- Real Time AI
  - Short-range integrated color and infrared depth sensors
  - Cutting-edge graphic processing
- Gentle Harvest
  - Does not contact the fruit
- Active Safety
  - LiDAR sensors ensure workers stay safe

Technic in Agrobot



Navigation

LiDAR

- Targets an object with a laser
- Measures the time for the reflected light to return
- This determines the object's distance

GPS

- A satellite-based radionavigation system

How it's used:

- Makes sure to keep surrounding field workers safe
- Uses LiDAR sensors to identify workers
- Has a virtual perimeter which stops the harvester when crossed

Gripper

- Mimics a scissor
- Grips at the stem and cuts below it
- Drops strawberries into field container

Robot Arm

5 DOF

The 5-DOF arm is **high cost** and its orientation will lock, keeping the gripper horizontal. This also made its **working space small**

3 DOF

The 3-DOF Cartesian arm is widely used due to its **simplicity and low cost**. Moreover, unlike the serial arm, it has no singularity problem and it has a **wider working area** if no rotations are required.

Fruit Identification

Image Processing

Short-range integrated color and infrared depth sensors are used to capture all details

Cutting-edge graphic processing units help to assess fruit ripeness.

Deep Learning

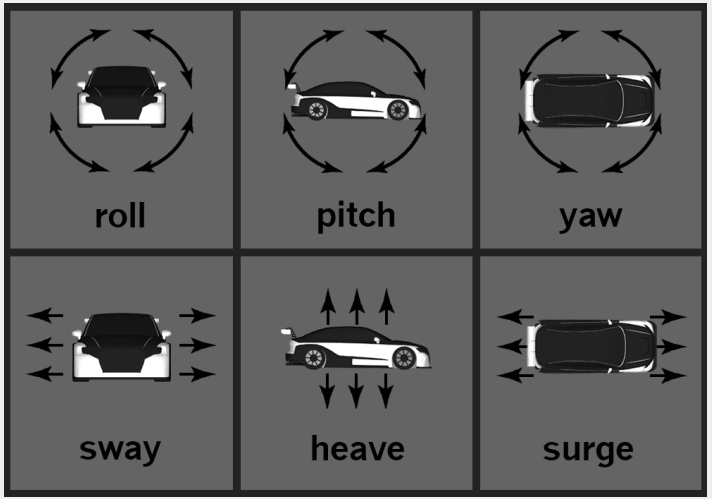
Convolutional autoencoder and backpropagation neural network is used

Amusement: Robocoaster

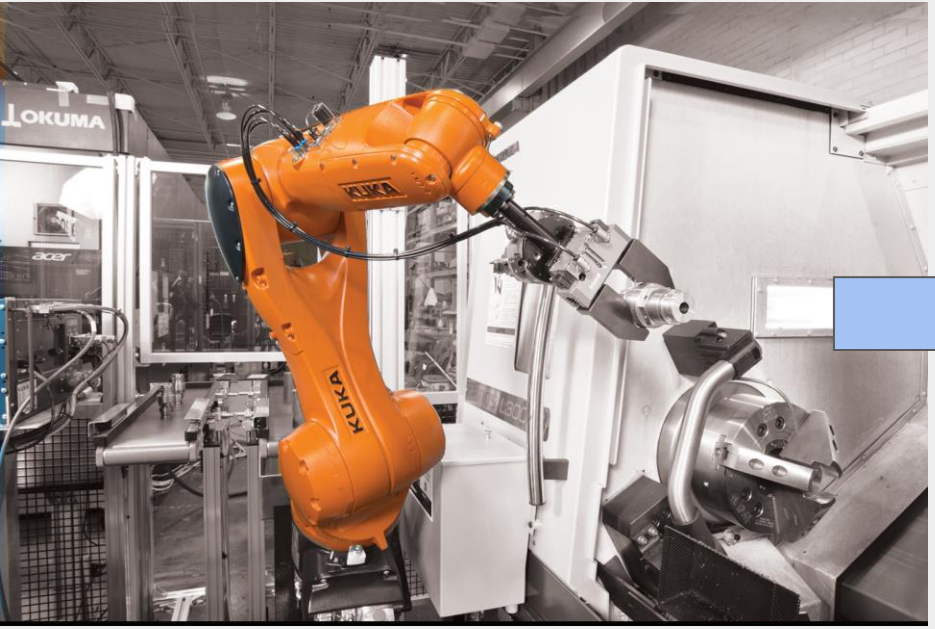
A new generation of thrill ride

Conventional Motion Simulator Rides

Conventional motion simulation ride vehicles achieve 6 degrees of freedom



Kuka Arm Robocoaster



First developed in 2000 by Gino De-Gol when the idea was hatched to mount a chair to the end of an industrial robotic arm

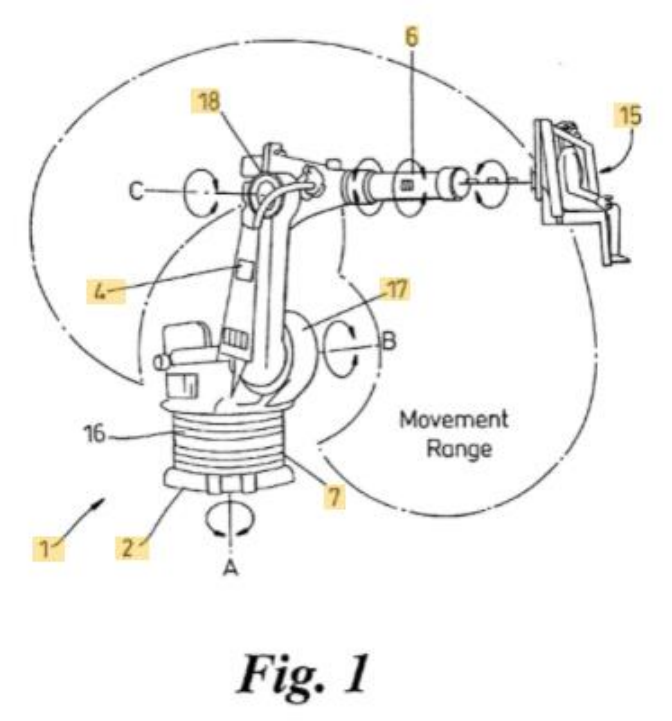


Fig. 1

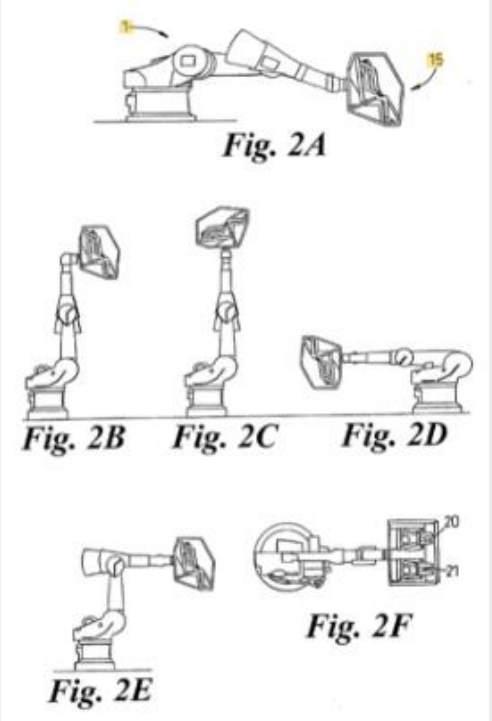


Fig. 2A

Fig. 2B Fig. 2C Fig. 2D

Fig. 2F

Fig. 2E

- Six-axis Kuka arm robots allow for a much larger range of motion, performing larger swoops (vs traditional motion base ride)
- Swoops can let riders experience nearly 2Gs

1st Gen Robocoaster

- Base fixed in place
- Ex: Knights' Tournament, Legoland
- Can allow guests to choose intensity level, or even 'design' ride motion

2nd Gen Robocoaster

- Base of arm attached to a bus bar track system that allowed it to move through different show scenes.
- Ex: Harry Potter & the Forbidden Journey, Universal's Islands of Adventure

3rd Gen Robocoaster

- Arm mounted to a roller-coaster track!
- Not yet built! Still in conceptual phase

A slide to end things off

+ Interactive element


Q&A