



# Virtual Reality and its Application to Healthcare

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# The World of VR

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## □ Virtual Reality Applications in Medicine

- Visualisation (virtual endoscopy, colonoscopy)
- Computer assisted surgery (training, planning, rehearsal, and delivery)
- Radiotherapy
- Dentistry
- Rehabilitation and therapy
- Telemedicine
- Phobias
- Education (teaching, training, determining level of skill)

## □ Key Virtual Reality Research

- Biological Tissue Modelling
- Haptic Interfaces
- 3D Visualisation



# Visualisation in Medicine

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## □ Visualisation is useful in many fields

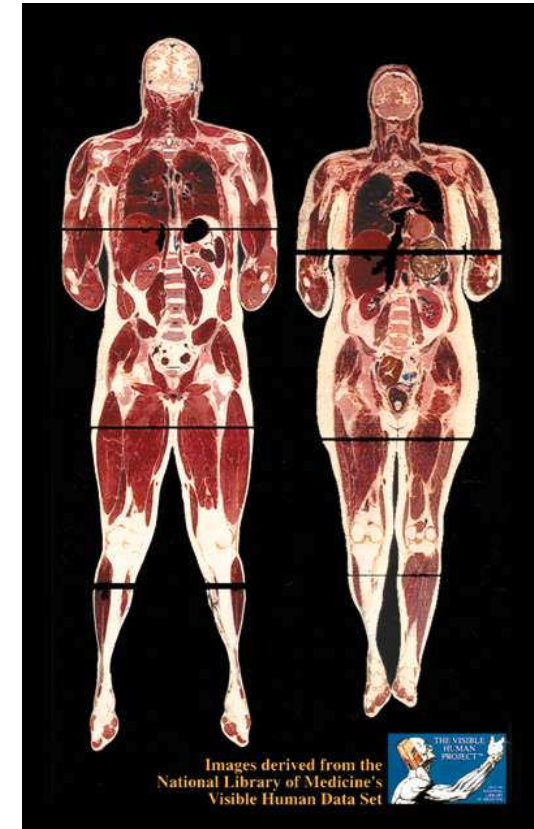
- Visualisation of anatomical structures
- Individual patient anatomy
- Image guided surgery procedures
- Planning radiation therapy

## □ 3-D Stereovision



# VHP

- Visible Human Project
- US National Library of Medicine ran the project
- Data free of charge
- Visible Human data has been used in many projects as a test data set
- Various anatomical parts have been used for educating medical students
- 3D anatomical models have been developed using the data
- Visible Human project has inspired several similar visual projects



# Surgical VR

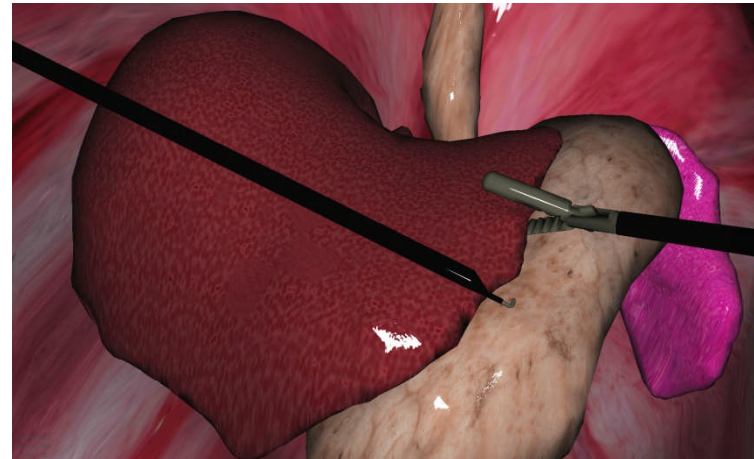
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- ❑ Surgical training
  - Educating surgeons
- ❑ Surgical planning
  - Visualisation of individual anatomical models
- ❑ Surgical rehearsal
  - Rehearsing complex surgical procedures
- ❑ Surgical delivery
  - Increases speed and accuracy of surgical procedures
  - Reduces patient trauma and risks
  - Assists surgeons during surgical procedures



# Surgery Training

- ❑ Studies show that doctors are more likely to make errors during their first few dozen surgical procedures
- ❑ There is a shortage of cadavers for medical research
- ❑ Its beneficial if medical training can be performed using a realistic imitation of a human body inside the computer
- ❑ Training can be used for:
  - Laparoscopic surgery
  - Emergency/Planned surgery
  - Organ transplant surgery



# No more cadavers

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## ❑ Training on cadavers has drawbacks

- If trainee slices a blood vessel in a cadaver nothing will happen
- No action can be reversed on cadavers (what is cut is cut)
- Dead tissue is harder, color is changed, arteries do not pulsate

## ❑ Advantages of computer simulations

- Procedures can be repeated many times with no damage to virtual body
- Virtual body does not have to be dead - many functions can be simulated for realistic visualizations
- Organs can be made transparent and modelled in motion



# Telesurgery

- ❑ Physicians can have a VR produced copy of a remote environment including the patient at their physical location
- ❑ Telesurgery is a telepresence application in medicine where the surgeon and the patient are at different locations
  - Injured in accidents have better chances if they can be operated at the scene of accident by a surgeon from a local hospital
  - Wounded soldiers can be operated on the battlefield by a surgeon who can be located elsewhere
  - Patients who are too ill or injured to be transported to a hospital may be operated remotely





# Phobias

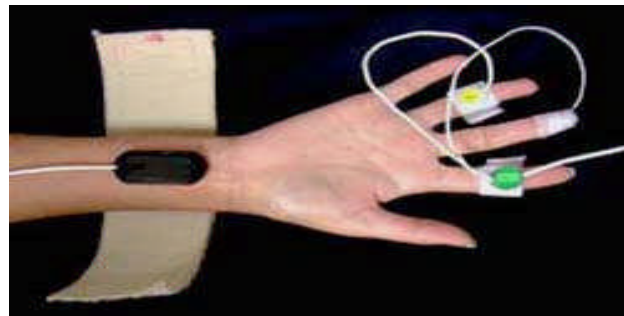
- ❑ Patient therapy sessions begin with less threatening situations and then go to more anxiety producing situations
- ❑ Fear of heights, fear of flying, spider phobia
- ❑ Acrophobia systems can be used for visualisations required to put patient on the top of a high building



# Anxiety & Phobias

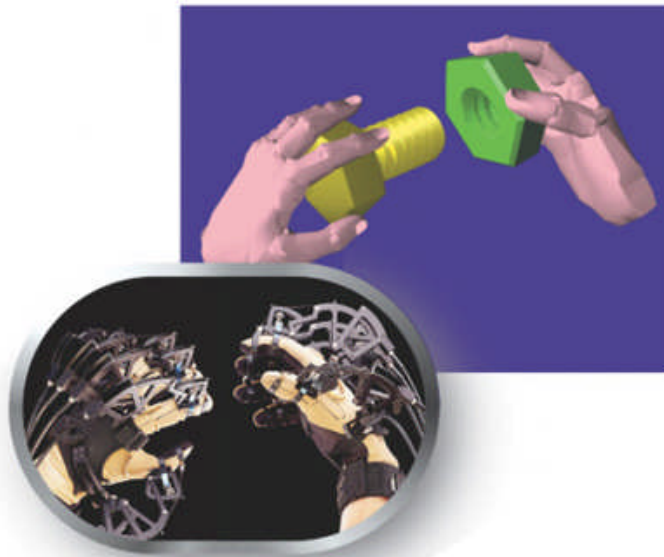
## □ Non-invasive Physiological monitoring

- Heart rate & HRV
- Respiration rate
- Skin conductance
- Peripheral skin temperature



# Force Feedback

- ❑ As well as visualising, force feedback (haptics) allows a more intuitive way of exploring virtual objects
- ❑ An additional dimension of immersion in virtual environments



- ❑ Types of device
  - Glove based devices
  - Minimally Invasive Surgery tools
  - Micro-tactile sensors
  - Stylus based devices

# Conclusion

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- ❑ Virtual reality in medicine is a subject of active research
- ❑ Active research is in the area of
  - Human-computer interfaces such as force-feedback and tactile interfaces which are important for medical use
  - Tissue modelling techniques for simulation of organs
  - Display techniques
- ❑ We can expect a new generation of diagnostic medical imaging techniques that utilise virtual reality concepts for effective visualisation of human anatomy
- ❑ New telemedicine applications





Thank You

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