



# Introduction to Multimedia Data Modelling

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# Multimedia Data ... ... Data Modelling



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# What are Multimedia?



# Multimedia Definition

**Multimedia** can be defined as a **combination of different forms of content** such as **text**, **graphics**, **audio**, **video**, and **animation**



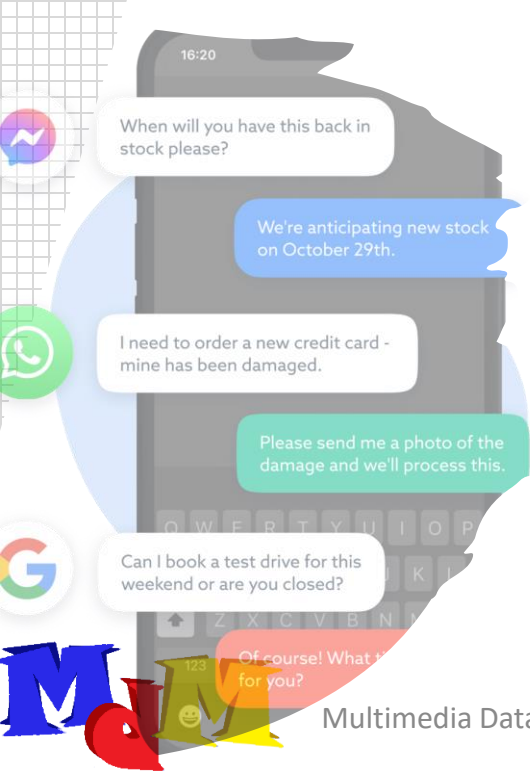


# Exploring the different forms of multimedia



# Text

**Text** is the most **basic form of multimedia**. It is used to communicate information and ideas in a concise and structured way. Text can be used to explain complex concepts, tell stories, and provide instructions.





# Graphics

**Graphics** are *visual elements that can be used to convey a message or an idea*. They can be used to illustrate concepts, highlight important information, and create an engaging experience. Graphics can be **static** or **animated**.



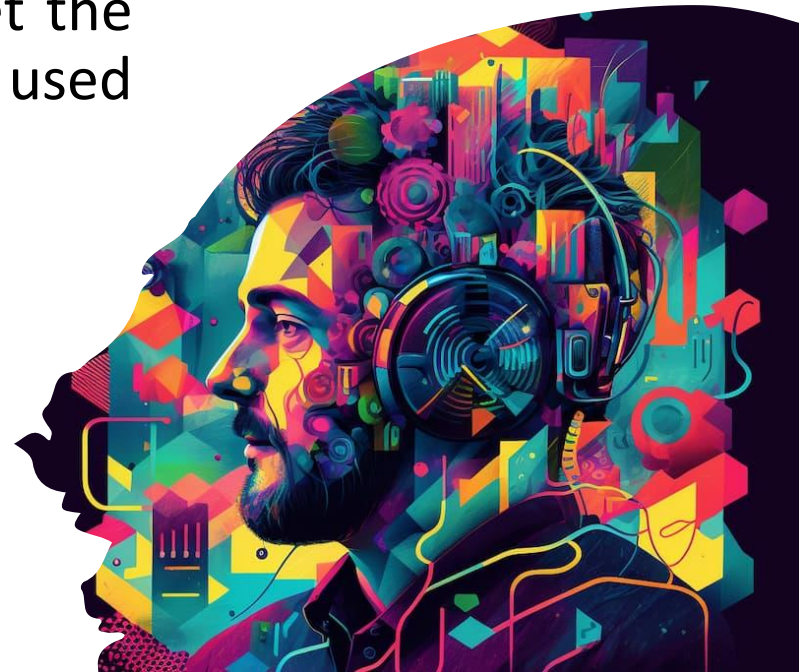
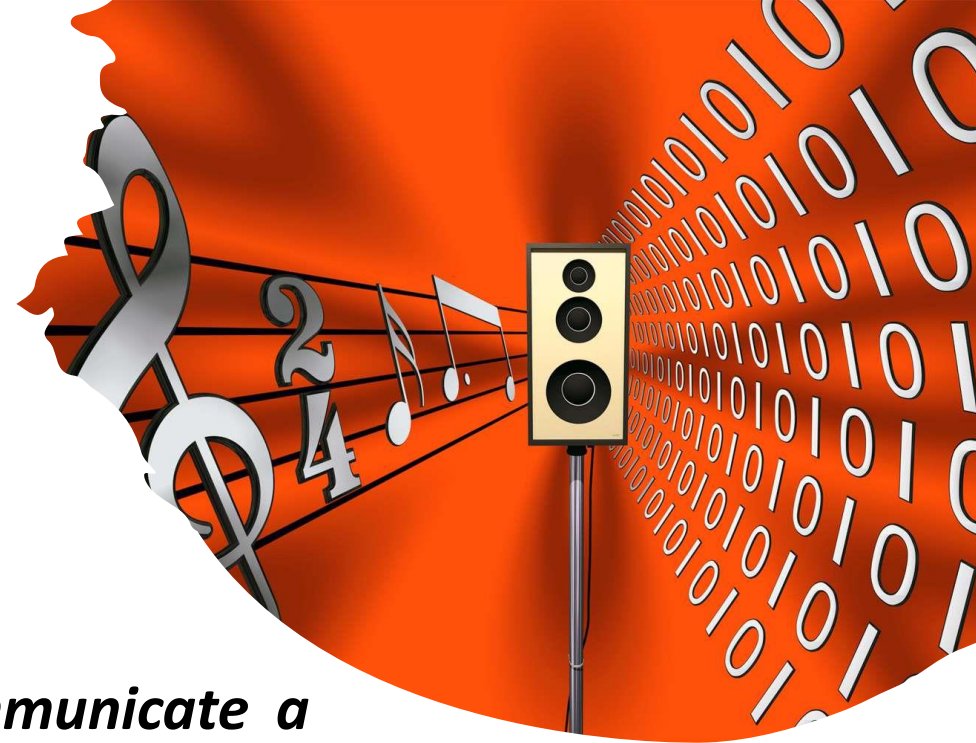
# Animated Graphics





# Audio

**Audio** is a type of multimedia that uses *sound to communicate a message*. It can be used to create an immersive experience, set the tone for an experience, and convey emotions. Audio can also be used to provide instructions and feedback.



# Video

**Video** is a type of multimedia that ***combines audio and visual elements***. It is used to communicate ideas in an engaging and visually appealing way. Video can be used to explain complex concepts, tell stories, and show how products work.



# Animation

**Animation** is a type of multimedia that ***combines graphics and audio***. It is used to create interactive experiences that are engaging and entertaining. Animation can be used to explain concepts, tell stories, and provide feedback.



# Multimedia Applications

**Education:** Multimedia has brought revolutionary changes in the field of education. It has made the system of education more attractive and effective than any other periods in the past. Now a day, multimedia presents the contents of education such as information, still and moving pictures, sounds pronunciations of words, clearly and attractively to the students. It is now possible to earn knowledge even staying at home through various multimedia software.



# Multimedia Applications

**Entertainment:** Invention of multimedia has opened a new horizon in the field of entertainment. Now a day, the various media of entertainment such as radio, television, VCR, VCD can be enjoyed through multimedia program. Besides this, playing games and drawing pictures in computer, on line chatting are the contribution of multimedia.

# Multimedia Applications

**Marketing:** In order to increase sales, large companies develop CD Rom software with different information like prices, uses, terms of sales of their products and services and distribute them to the probable customers. Therefore, the buyers can buy their required products by knowing the prices, terms of sale etc. from the CD even staying at home or office.



# Multimedia Applications

**Communication:** Today, multimedia has brought audio and video conference. These computer and electronic based communication creates dynamism in business, social, political, economic and international activities.



**Research:** Researchers require different kinds of information to conduct their research and development works. Internet plays a vital role in obtaining the necessary information. By searching the Internet the researchers can gather their required information and make successful research.

**On the Application of Multimedia Processing to Tele-**  
Richard Cox, Barry Haskell, Yann LeCun, Behzad Shahraray, and Lawrence Rabiner  
Speech and Image Processing Services Research Lab  
AT&T Labs-Research, Florham Park/Newman Springs, New Jersey, USA

## 1. Introduction

## 1. Introduction

In a very real sense, virtually every individual has had experience with multimedia systems of one type or another. Perhaps the most common multimedia experiences are reading the daily newspaper or watching television. For most of us, when we think about multimedia and the promise for future communications systems, we tend to think about systems that combine video, graphics, animation with special effects (as seen in movies like 'Who Framed Roger Rabbit') and CD quality audio. On a more business oriented scale, we think about creating virtual meeting rooms with 3-dimensional realism in sight and sound, including sharing of whiteboards, computer Business Meeting Notes for computer-generated meeting in an efficient communications environment. Other glamorous applications in which we learn and interact with instructors remotely over a broadband communication network, Virtual Library Access in which we instantly have access to all of the published material in

**Abstract** - technology is developing quickly. Multimedia, a form of technology, is being used as a teaching tool these days. Many researchers and educators have found suitable ways to design multimedia applications in order to achieve fruitful educational outcomes. Not that all we are going to discuss here, the definition of multimedia, and the connection between multimedia and learning tools, concept of multimedia applications, how they are formed using a different media, the type of educational element that effect to learn in their natural environment, and the world issues. The study also includes instructional materials and multimedia products are arranged as articles.

# n gather the

Introduction

In the 1990s, we began to use audio and video slides, overhead transparencies, etc., to assist in the teaching process inside the classroom. The word 'multimedia' describes a combination of different media. When computers became prevalent in society, people started using them to perform various tasks to make their life easier. Computers are a powerful resource that we can use for many things. Interactive multimedia is a reliable technological innovation, and it has the potential to modernize the way we read and explore educational things. Multimedia is an interactive as well as educational tool. These types of interactive tools are likely to make educational subjects more interesting. The objective of using multimedia as an educational tool is not to eliminate the teacher from the classroom; rather, it is just a tool, which makes it easier for both students and teachers to learn as well as teach particular subjects. Multimedia tools include well-designed programs that simulate the teacher's role by adding various educational elements to the cognitive process. The learning process involved in multimedia programs facilitates active learning and ensures that users are practicing a subject rather than merely reading about it. Actual communication between multimedia programmes and students constitutes a proper learning process. Interactive multimedia is a new technology that is

introducing new methods in the learning process to the new generation. Teachers should be able to easily access these multimedia applications to monitor their students' progress and modify the application's contents according to the students' characteristics.

Park and Hannafin stated that most of the aspects of interactive multimedia systems, which are used for teaching, are questionable. Here, we can see the difference between computer-based learning environments and multimedia systems. In multimedia systems, there are many multimedia choices available to choose from, it is important for developers of these instructional multimedia systems to know the necessity of using them in their applications. Interactive multimedia applications are crucial, as they are the only reason for the existence of the research in this field. The elements and implications of building an educational multimedia system. We will also discuss theories, which can be used to build a proper guidance system for developers to build and select the proper elements to build multimedia systems. Finally, we will review several different educational elements that can be used for educational purposes for multimedia systems.

## II. Multimedia

Before starting discussion on our topic, we must clarify the definition of 'Multimedia'. The word 'Multimedia' is a reasonably new one in the field. It is used to describe several different mediums when they are merged together. We can define multimedia according to its common characteristics: texts, graphics, animations, video, and sound. These are all combine to create multimedia, but they can also be organized and presented differently. In other words, multimedia can be define as numerous media elements combined into one whole subject, which produces fruitful outcomes for its end user. All these media elements are making communication more organized and clear than ever before.

Several researchers have provided definitions of multimedia. Moore et al. defined multimedia as follows: the use of numerous media devices in a



# Multimedia Applications

**Virtual Reality:** Virtual reality is a technology which allows a user to interact with computer-simulated environment. The simulated environment can be similar to the real world. For example: simulation for pilot or combat or surgery training. This simulated environment can also differ significantly from reality, as in virtual reality games. This virtual reality is actually based on multimedia boulder technology.



## Metaverse

# Brief introduction to the Metaverse





# Metaverse



# A first definition

Metaverse, a term born in the cyberpunk world in 1992 and now in the limelight because it is used by Facebook, is the evolution of the Internet, but does not replace it. This is a difficult concept to define exactly, which prefigures a set of interconnected virtual and real worlds, populated by avatars. There are many questions still open

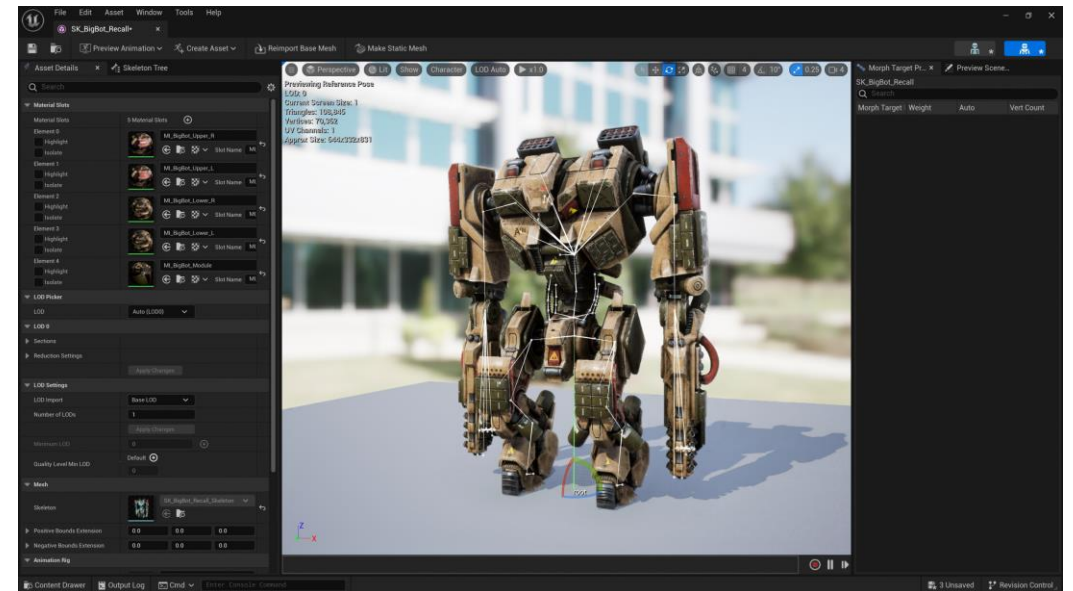




**UNREAL  
ENGINE**



**Unity**



Multimedia Data Modelling

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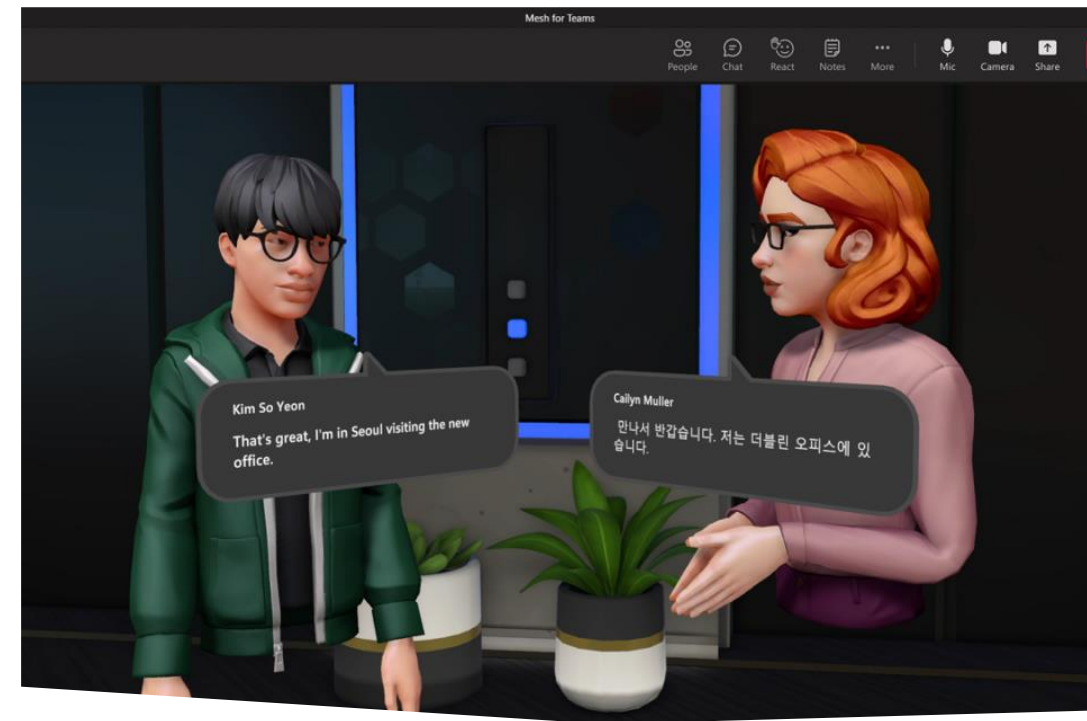
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## Meta = Metaverso & Facebook

The Metaverse is not new, but it rose to prominence with the announcement of Facebook, which decided to name the Group's holding company (which controls the Facebook, Whatsapp, Instagram and Oculus platforms) "Meta" and to start a project with this name, a project about which little is known yet.





# Mash = Metaverso & Microsoft

A few days later, Microsoft announced that from 2022 it will integrate the Metaverse into the Teams platform with a feature called Mash: users will be able to create an avatar with which to participate in work meetings.





Metaverse is the future of the Internet, a set of virtual spaces crossed by avatars, a step forward compared to virtual reality.



A person is shown from the chest up, wearing a VR headset. The image is heavily stylized with digital glitch effects, featuring horizontal lines of various colors (blue, green, red, yellow) and pixelated distortions across the entire scene. The person's right hand is raised, with the index finger pointing upwards. The background is black.

*... The metaverse is a virtual space, but its impact  
will be real ...*

- <https://about.meta.com/it/metaverse/impact/>



# The benefits of the metaverse to society are immense

The metaverse will connect people to a new range of experiences: from immersive sessions in education and training, to incredible possibilities for healthcare and workplaces.





*"With the metaverse, one day firefighters will have the tools to rescue more people in less time."*







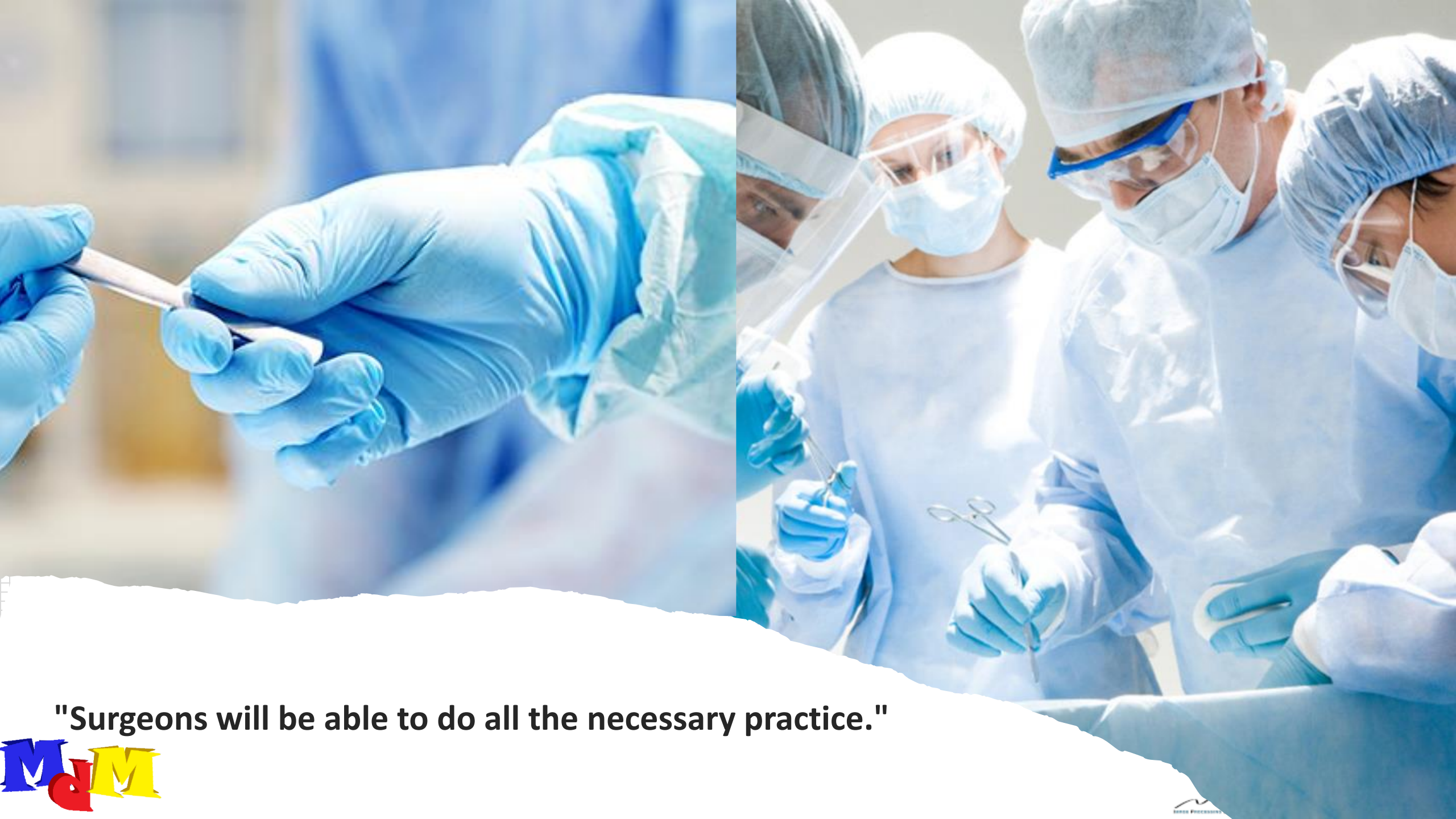




***"One day doctors will be able to view diagnostic images like never before and make decisions more quickly."***







**"Surgeons will be able to do all the necessary practice."**











"Students will take a field trip to the Ice Age to rediscover the past."









**"Urban planners will be able to run simulations to help reduce traffic."**







# Ways to enter the metaverse





***Eyeglasses  
Smart***



***Augmented  
reality***



***Virtual  
reality***

# Metaverse, how to access?



A woman with long dark hair is wearing a purple VR headset and looking upwards. She is in a music studio, with her hands near a keyboard and a mixing console. In the background, there are large curved screens displaying digital audio workstation (DAW) software with various tracks, waveforms, and mixing controls. The scene is dimly lit with warm ambient lighting.

# Virtual reality

Virtual reality allows you to discover new worlds and new shared experiences. Live new experiences with your friends and family, even if you are far apart.



A man with a beard is looking out of a window at a city at night. The city lights are visible in the background, and the man is wearing a dark hoodie. A faint watermark "Meta Quest Pro" is visible in the center of the image.

Meta Quest Pro

Example of Virtual Reality

<https://www.youtube.com/watch?v=YaRastZmucQ>



# L'avventura ti attende con Meta Quest 2

Ora con due fantastici giochi inclusi (valore fino a € 43).  
Divertimento infinito. L'esperienza completa. Termina il 3/6.\*

[Acquista Meta Quest 2](#)

[> Scopri di più](#)





# Augmented reality

**Through photos and videos, AR allows you to improve shared experiences with fun virtual effects that are activated simply by swiping your finger on the screen, leaving you the freedom to express yourself with the most important people in your life**



# Augmented reality for plant maintenance

[https://www.youtube.com/watch?v=tIWu5g2\\_6XA](https://www.youtube.com/watch?v=tIWu5g2_6XA)

# Multimedia: Film & Cinema





# Film & Cinema

**Film** means single media or multimedia entertainment content for distribution or exhibition to the general public by any means and media in any digital media format, film, or videotape, including, but not limited to, a motion picture, a documentary, a television series, a television miniseries, a television special, interstitial television programming, long-form television, interactive television, music videos, interactive games, video games, commercials, internet programming, an internet video, a sound recording, a video, digital animation, or an interactive website.

# Multimedia: Application an Digital Forensics





# Forensic Science

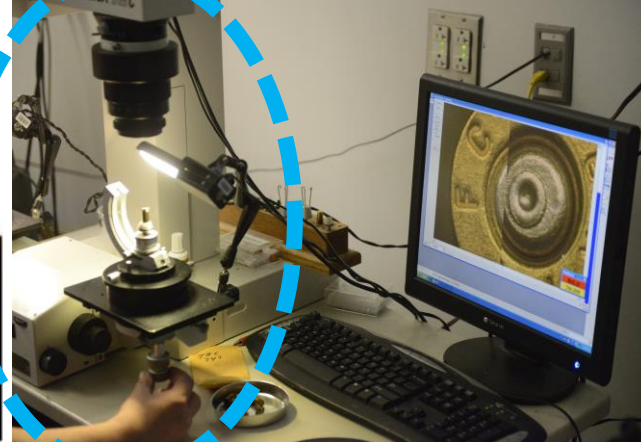
(sometimes shortened to **Forensics**) is the application of technical and scientific methods to the justice, investigation and evidence discovery domain.



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# Forensic firearm ballistics

**Forensic firearm ballistics** is the science of examining the characteristics of **firearms**, **cartridges**, and/or **bullets** found at a crime scene.



- Ballistic Forensics Specialists are tasked with tying this evidence to crime suspects.
- [Comparison Microscope](#)



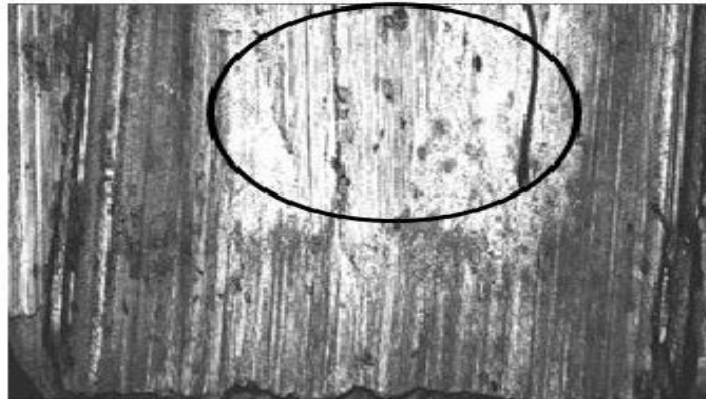
# Forensics Examination of Firearms



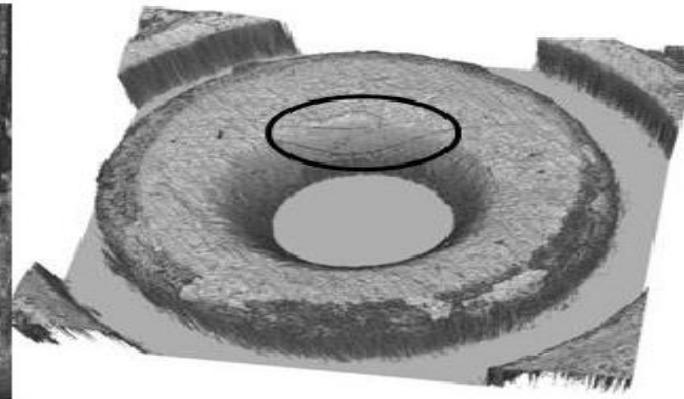
Weapon serial numbers



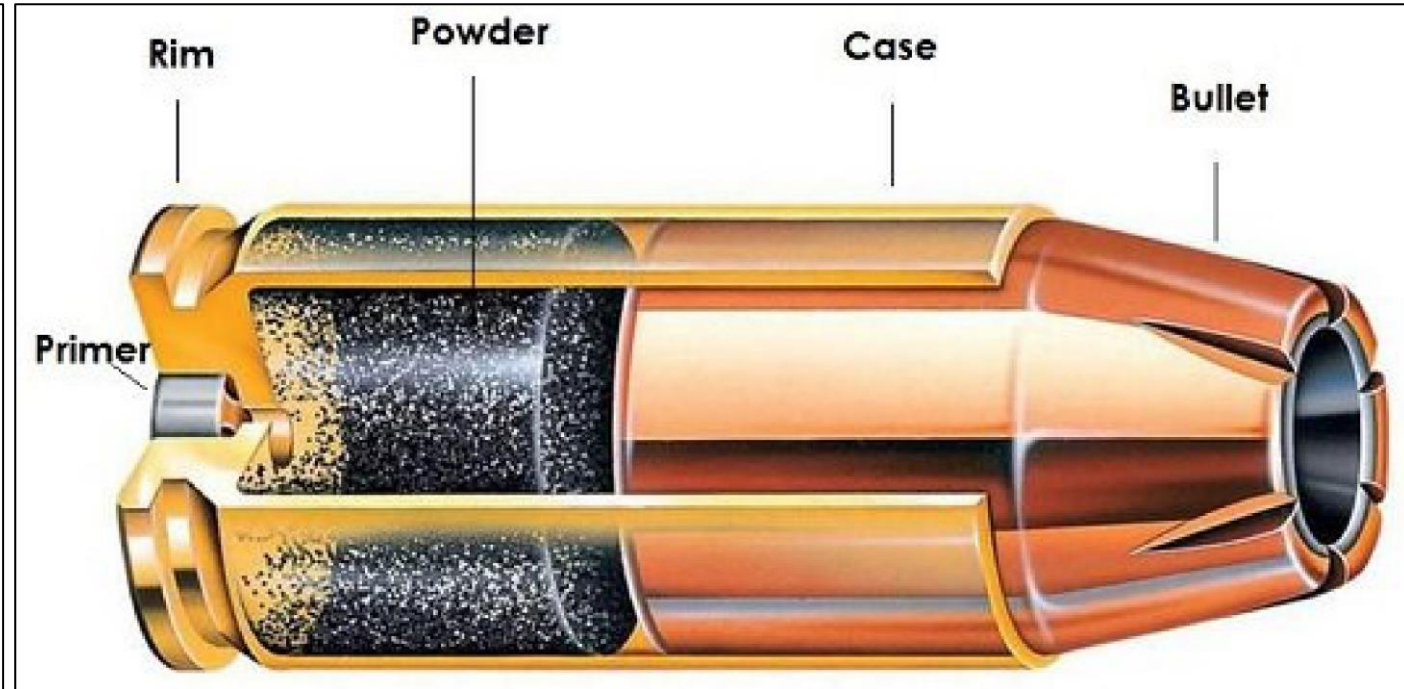
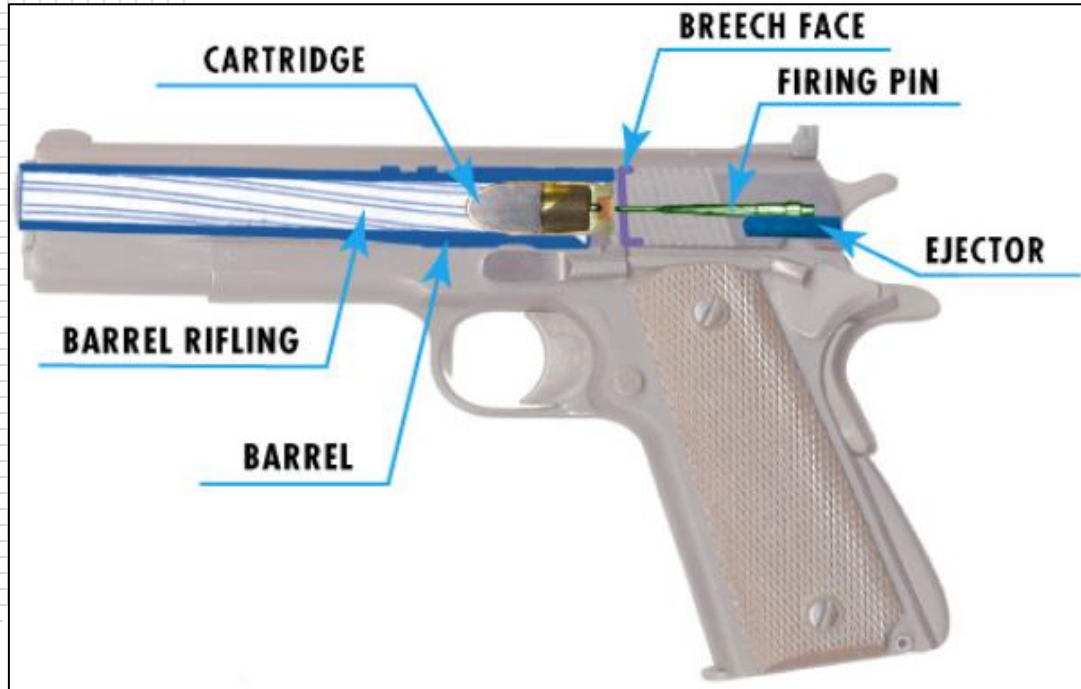
Fingerprints on the weapon's surface



Ballistic striations



# Firearm and Cartridge components





# Weapon firing process



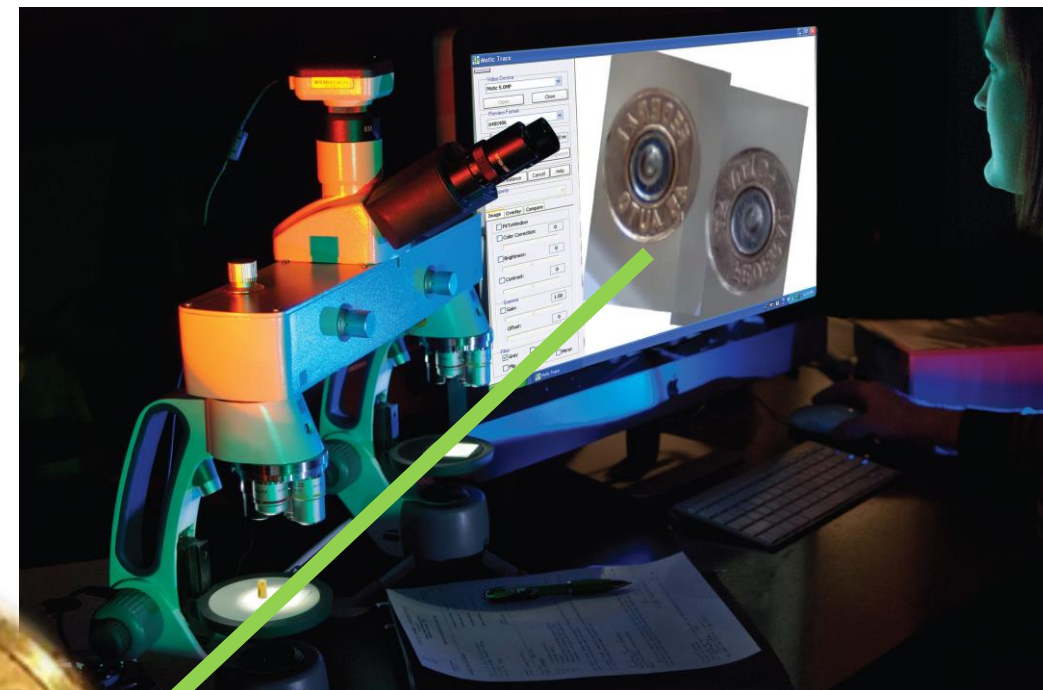
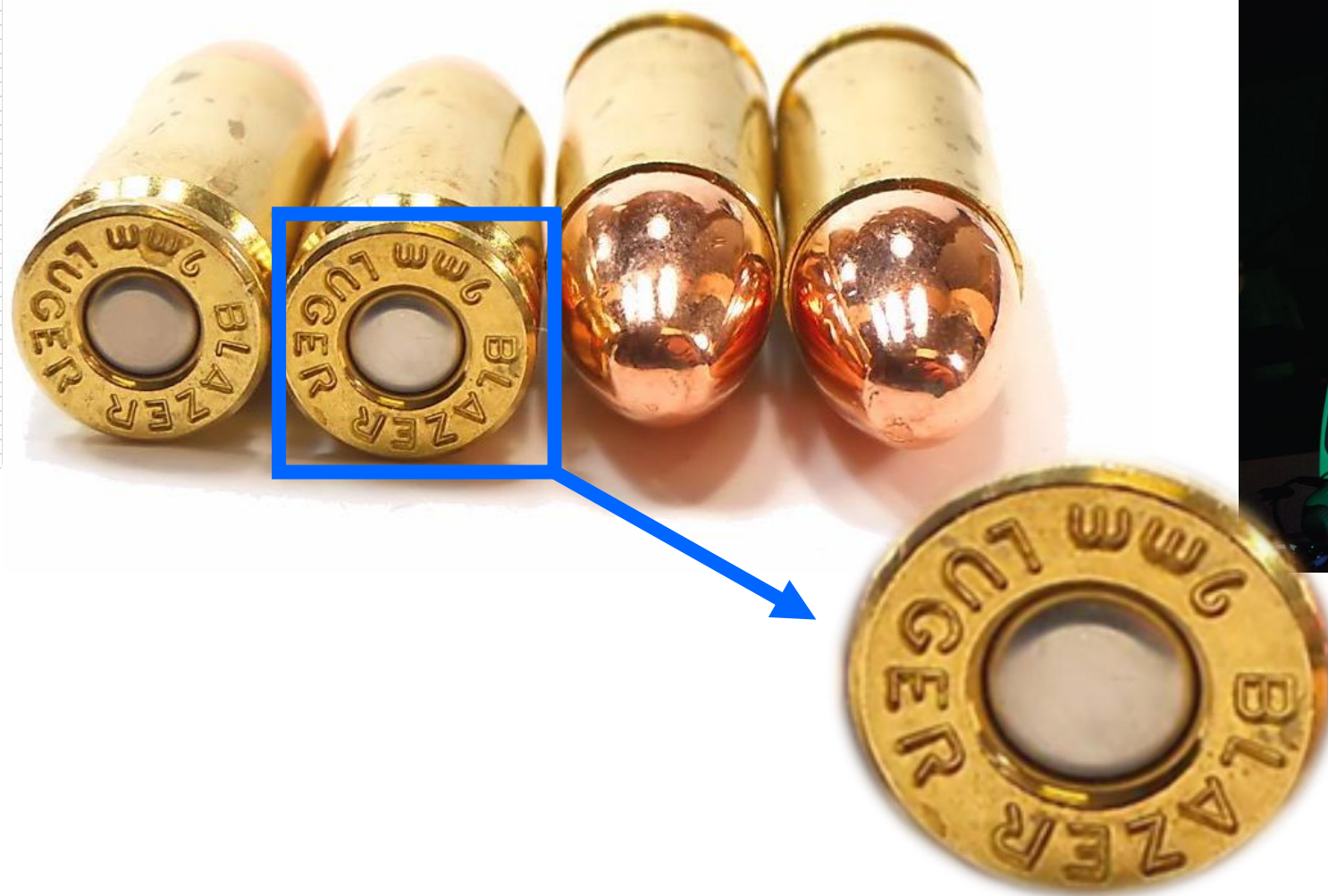
The weapon **loading**

The **shot**

The cartridge **ejection**



# Cartridge Analysis





# DEMO - 3D Forensic Ballistics Comparison



<https://iplab.dmi.unict.it/mfs/Forensic-Firearms-Ballistics-VR/>



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**iCtLab**  
Digital Forensics



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# Assessing Forensic Ballistics Three-Dimensionally through Graphical Reconstruction and Immersive Observation

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# Opportunities for Students



# Thesis



**Students will be able to use advanced technologies in order to implement applications in the immersive environment through tools such as Meta Quest.**



# Some Topics

- Applications in Forensics:
  - Virtual laboratory (basic and manual) for crime scene analysis: dynamic reconstruction; scene analysis; educational laboratory; etc....
- Applications in AI Forensics:
  - Machine and Deep Learning algorithms for forensic investigations in immersive environments: Intelligent Forensic Laboratory with object detection, object recognition, automatic labeling of objects in the scene, and more...
- Applications in other fields (chosen by students)

# Main skills/requirements

- Basic knowledge of object-oriented programming

**Depending on the application to be made, it is preferable that the student also knows**

- Basic Knowledge of Computer Graphics, Unity, C# language (or Unreal and C++ language)





# Multimedia Data ... ... Data Modelling



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Multimedia Data Modelling

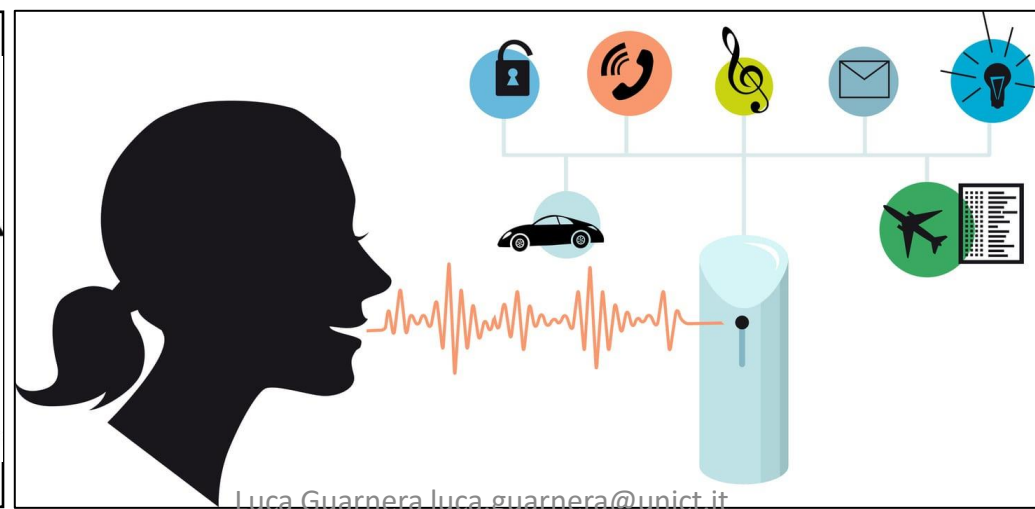
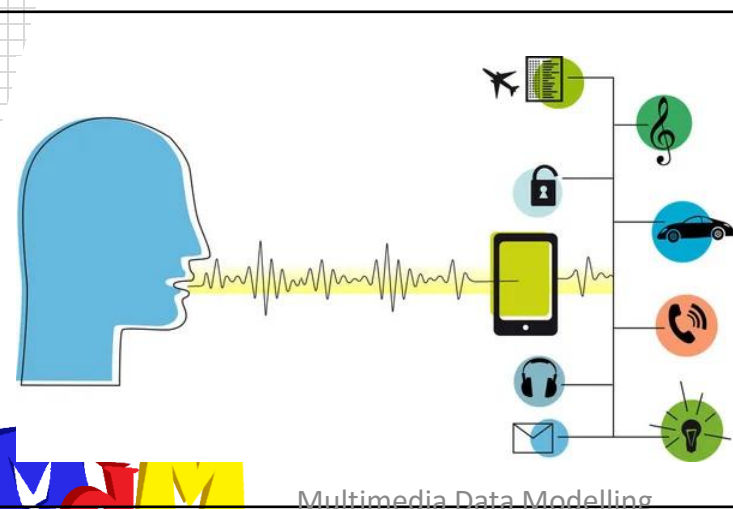
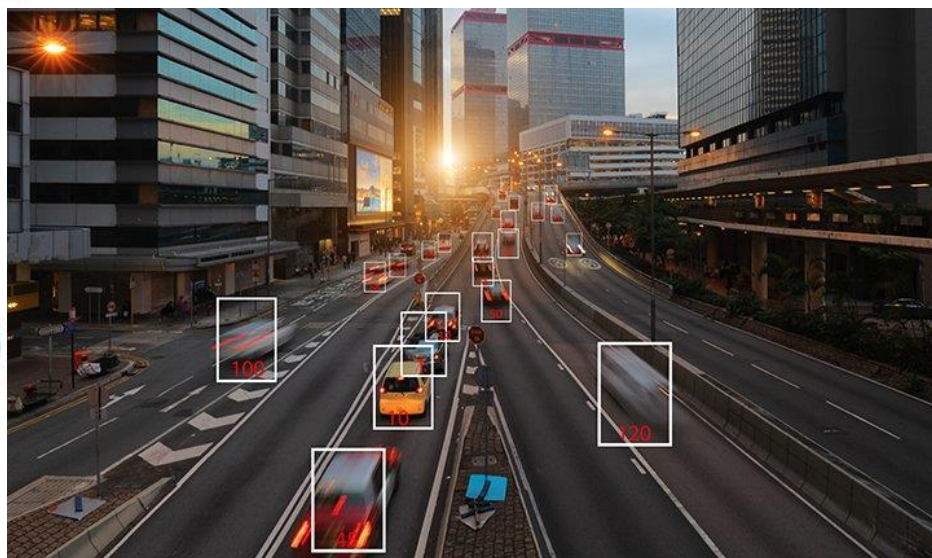
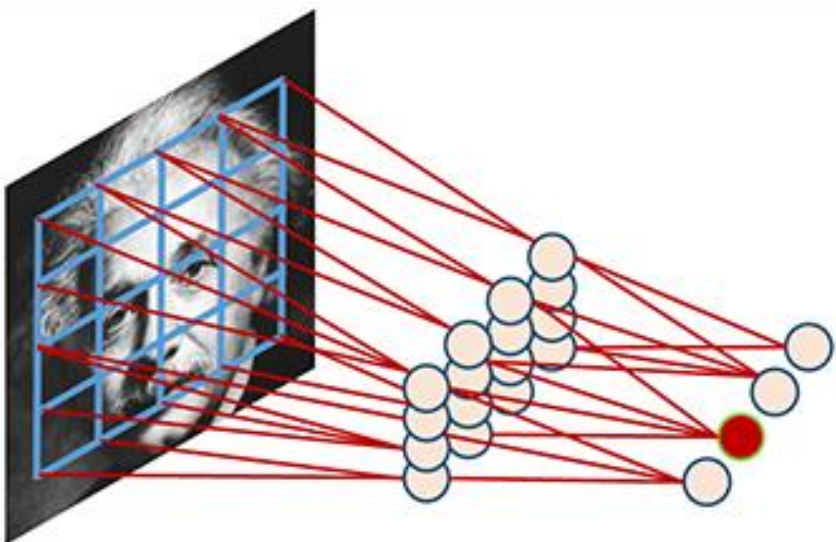
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# ... Data Modelling





# Applications

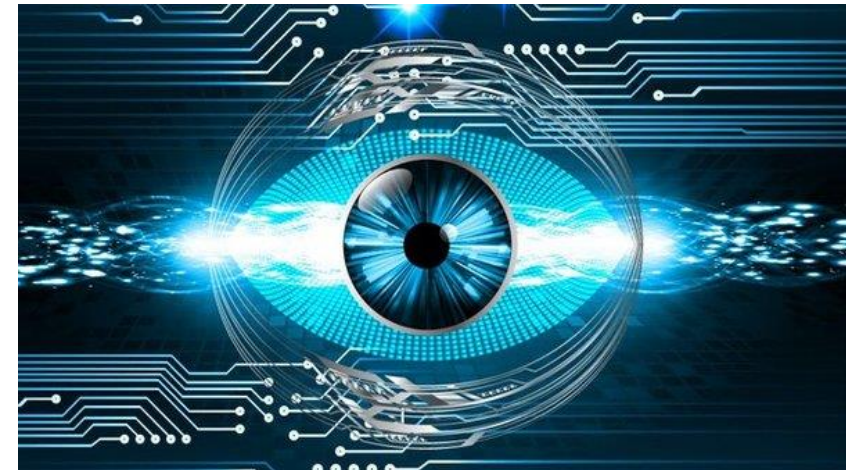
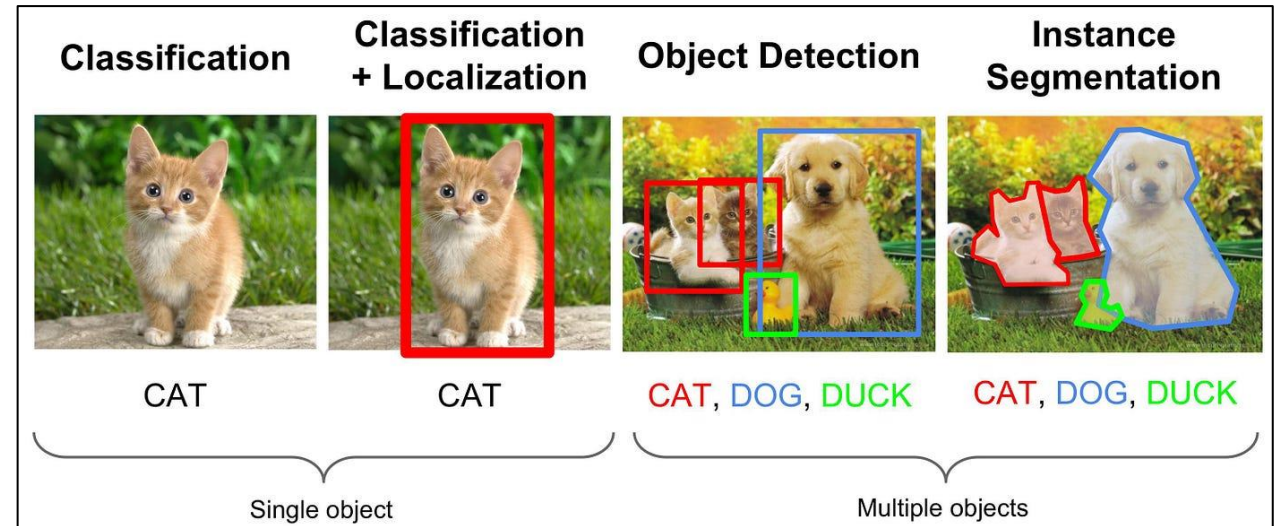
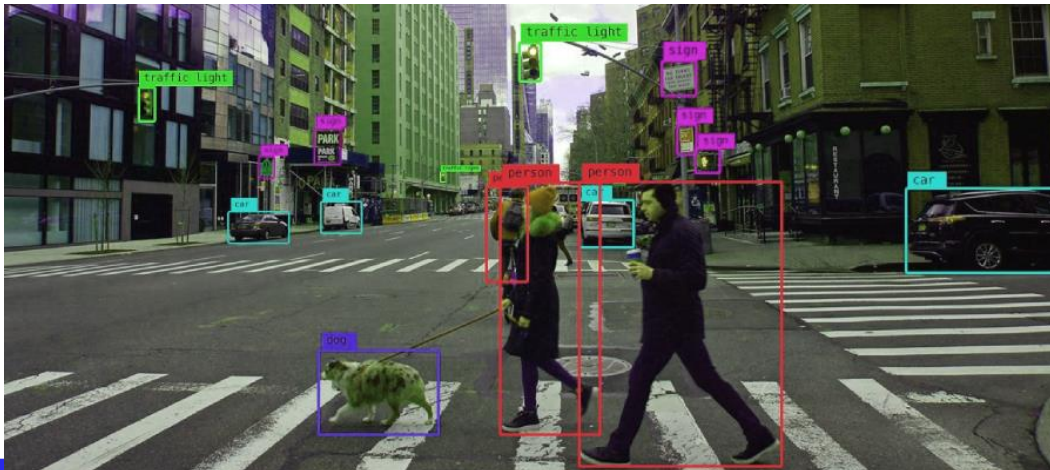


Multimedia Data Modelling

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# Applications





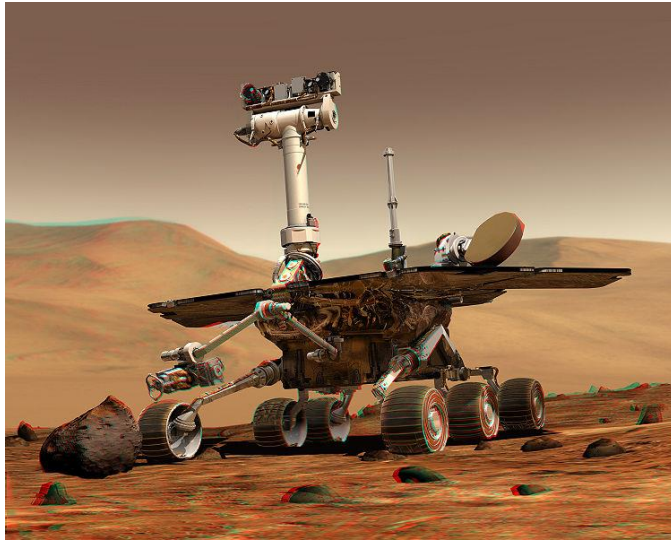
# What is Computer Vision?

**Vision** is perhaps the most important sense that humans possess. It enables us to infer the three-dimensional world, recognize and locate objects in a scene, perceive rapid changes in the environment, etc.

**Computer Vision** is the discipline that studies how to enable computers to understand and interpret visual information present in images or videos.

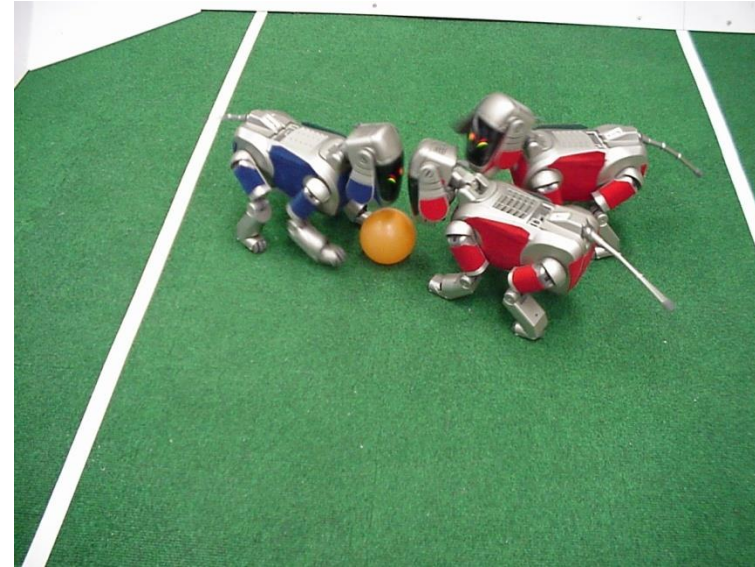


# CV Applications: Mobile robots

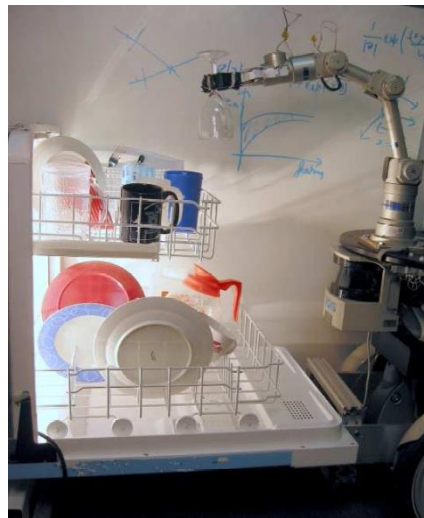


NASA's Mars Spirit Rover

[http://en.wikipedia.org/wiki/Spirit\\_rover](http://en.wikipedia.org/wiki/Spirit_rover)



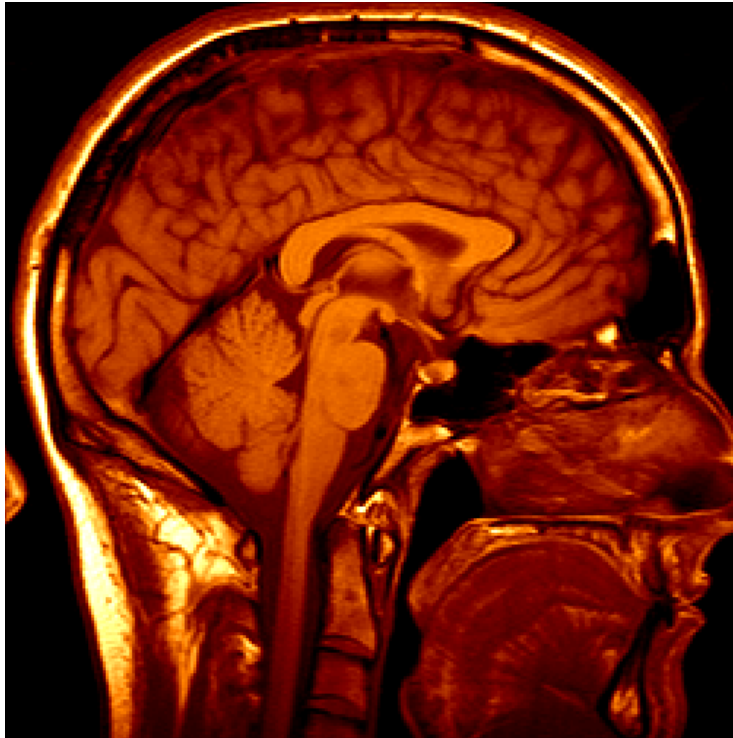
<http://www.robocup.org/>



Saxena et al. 2008  
STAIR at Stanford



# CV Applications: Medical imaging

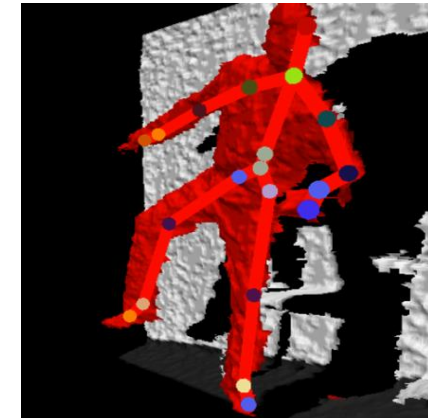
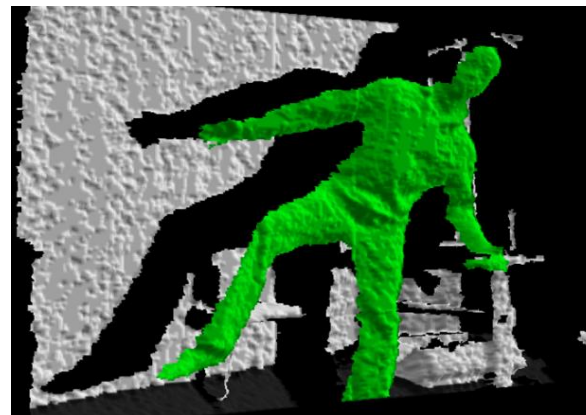
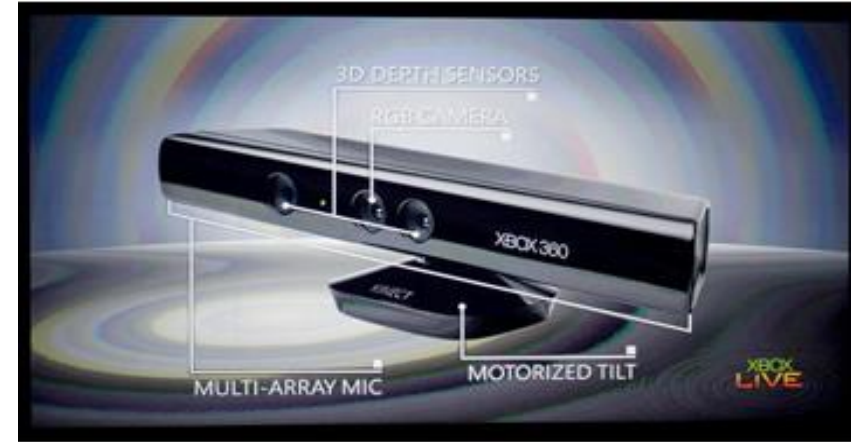


3D imaging  
MRI, CT



Image guided surgery  
Grimson et al., MIT

# Vision-based interaction: Xbox Kinect



<http://electronics.howstuffworks.com/microsoft-kinect.htm>



# CV Applications: Safety and Security



Goal:

Camera Stereo – Real time monitoring of dangerous conflicts (car, pedestrian, etc.)

Real-time traffic monitoring

# Computer Vision Goals

- Build systems capable of making decisions starting from a description of the scene extrapolated from images/videos;
- Infer the 3D world from digital images;
- Recognition of objects, scenes, context from digital images.
- ....





# Opportunities for Students (2)



# Thesis

- Deepfakes:
  - Creation
  - Detection
  - Adversarial
- Digital Forensics
- Computer Vision Task
- ...







# Questions?



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# Let's start with the course program ...



Multimedia Data Modelling

Multimedia Data Modelling



# Details

- **The first part of the course is about digital images**
- The second part of the course is about digital video
- The third part of the course covers Low-Level Vision
- The fourth part of the course concerns modeling and processing of digital data





# Introduction to Multimedia Data Modelling

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