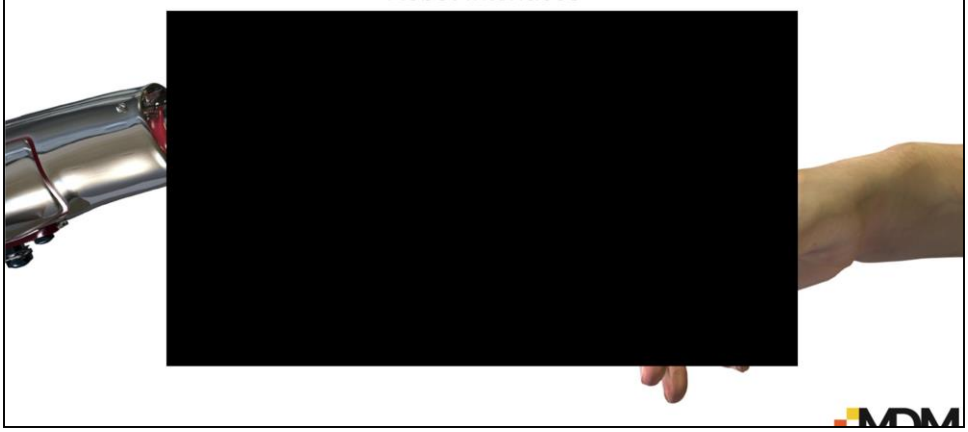
RYERSON UNIVERSITY

School of Computer Science

Human Robot Interaction

Robot Interfaces



RYERSON UNIVERSITY

School of Computer Science

About This Class

- Source Material
  - "Critical Decisions for Human-Robot Interface Development"
  - "A Video Game-Based Framework for Analyzing Human-Robot Interaction: Characterizing Interface Design in Real-Time Interactive Multimedia Applications"
- Topics
  - User Design Principles
  - The HRI/HCI difference
  - Things to consider
  - A Case study

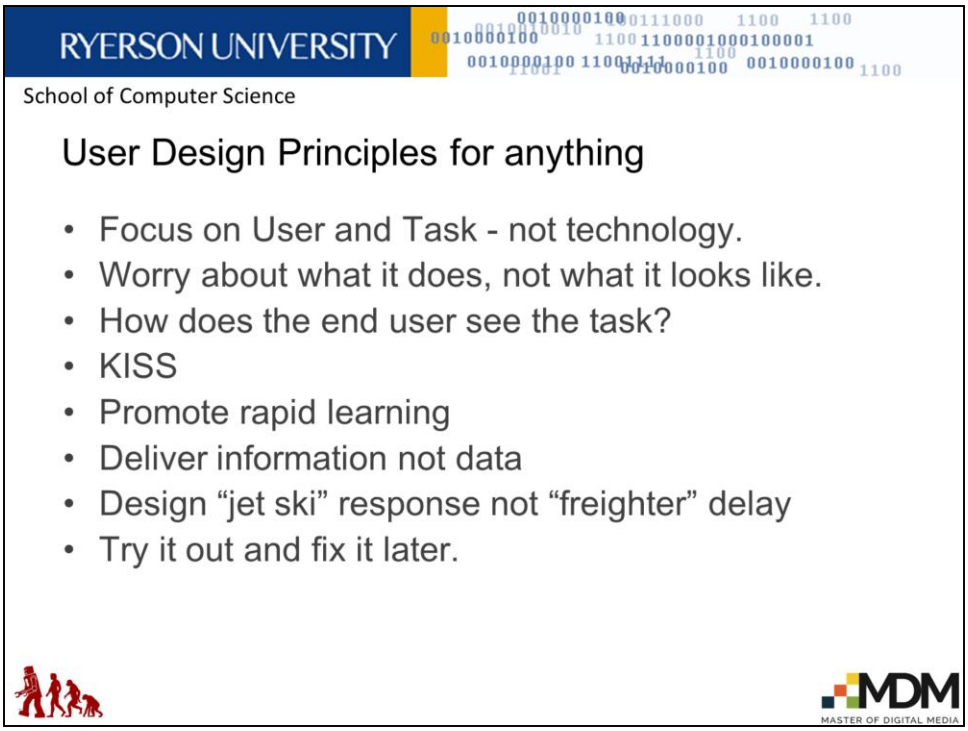
MDM
MASTER OF DIGITAL MEDIA

Available on the course web site. A good paper.

RYERSON UNIVERSITY

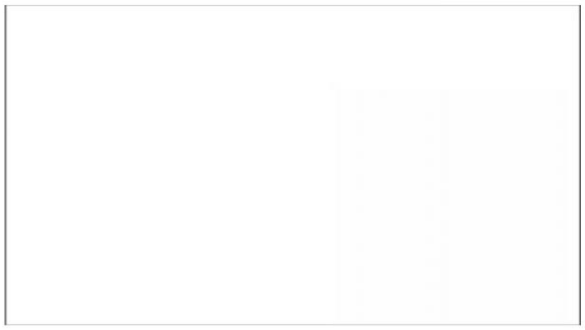
School of Computer Science

Don Norman and the Design of Everyday Things



J. Johnson, **Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules,** 2000

Be Cautious About Design



RYERSON UNIVERSITY

School of Computer Science

How is HRI different from HCI?

- Many Human-Computer Interaction (HCI) interfaces are created from the perspective of the human via “Human-Centered Design”
  - “User Centered Design is a philosophy and a process. It is a philosophy that places the person (as opposed to the thing) at the center; it is a process that focuses on cognitive factors (such as perception memory, learning, problem-solving, etc.) as they come into play during peoples’ interaction with things.”
  - Human interfaces should be “Humane”

MDM
MASTER OF DIGITAL MEDIA

Katz-Hass 1998

RYERSON UNIVERSITY

School of Computer Science

There is a problem with HRI

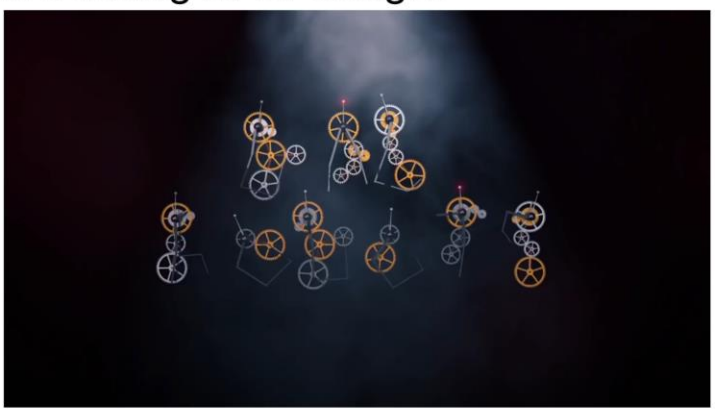
- Good UI design Easy to say hard to do
- Machine is now a “partner” in many taxonomies
- Machine is now an “arbitrator” in others
- Understanding only the “user and the task” without considering the robot is similar to trying to score in hockey without knowing anything about the stick.

MDM
MASTER OF DIGITAL MEDIA

RYERSON UNIVERSITY

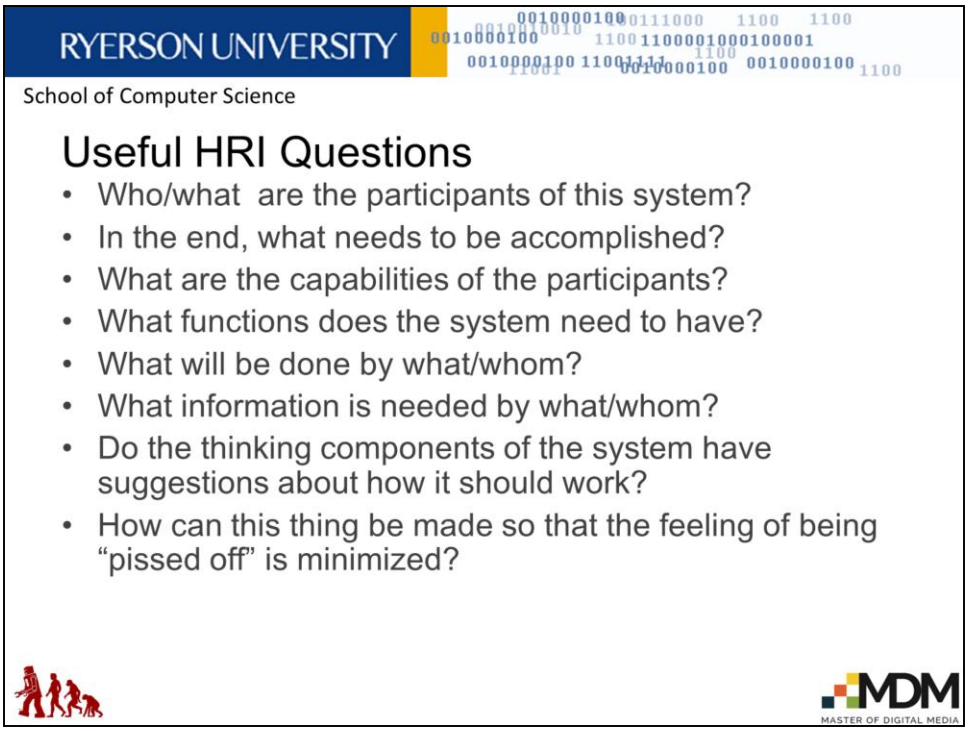
School of Computer Science

Understanding the User and the Task and Still Sucking at UI design!



MDM
MASTER OF DIGITAL MEDIA

The garden path



Bastardization of **KATZ-HAAS, R.**, 1998. User-Centered Design and Web Development. *Usability Interface*

Whatever you do…test it!

- Simulation can help in UI design, even without the actual system.
- Simulation gives a false sense of security.
- Use real participants.
- Use a real environment.
- Test much and test often.
- Accept what happens.

MDM
MASTER OF DIGITAL MEDIA

Making decisions: people can make high-level decisions easily, does this mean that robots should make low-level ones?

Vigilance: People have a hard time maintaining interest for long periods of time. They miss things

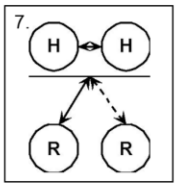
Workload: Sensor and reasoning systems can be overwhelmed easily

Situational awareness: You and the robot may not be subject to all information

Errors: Shit happens.

Lets Talk about an HRI System

- Defensive Robot controlled by a team of humans
- Environment:
  - Ambiguous and dangerous
  - Involves water and air
- Many humans
- Many robots



RYERSON UNIVERSITY

School of Computer Science

Case Study: Aegis

RYERSON UNIVERSITY

School of Computer Science

Aegis

- First fully integrated combat system built to defend against advanced air, surface and subsurface threats.
- Designed and developed as a complete system, integrating state-of-the-art radar and missile systems.
  - The missile launching system, the computer programs, the radar and the displays are fully integrated to work together.
- Capable of simultaneous warfare on several fronts
  - air, surface, subsurface and strike.
- Anti-air warfare elements include the radar system, command and decision system and weapons control system.

MDM MASTER OF DIGITAL MEDIA

Name form the Greek myth of the impenetrable shield of Zeus. Pronounced “EE Jis”.

The $500 million Aegis radar and weapons control system was tested by setting it up near Exit 4 of the New Jersey Turnpike where it merely watched the local general aviation traffic. It's first "active" test involved the shooting down of 10 out of 11 drones, all on courses known in advance to the system operators.

Deployed on the Ticonderoga Class ships, the Aegis first saw combat in the Persian Gulf in 1988. On July 3rd the system locked onto Iran Air Flight 655--an Airbus 300, and mis-identified it as the much smaller F-14. The Aegis also reported that the target was descending even though the airbus was, in fact, climbing, and erred on the altitude by 4000 feet. The combination of all these errors convinced the Captain that his ship was under attack, and the Airbus was shot down.

The total cost for the AEGIS weapon system is US$42.7 billion.

The Aegis System involves some 600 contractors.

Aegis assumptions

- Design criteria
  - Cold War
  - “blue water” battles
  - Provide Levels of automation
- Components
  - Radar
  - Computer
  - People
  - Missiles
  - Command, Control, Communications, Intelligence (C^3I)

Background brief:

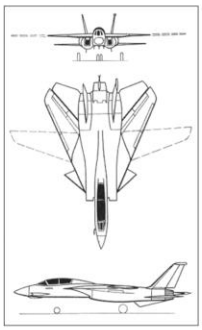
- It is 0500 on July 3, 1988 Straight of Hormuz, Persian Gulf off the coast of Iran
  - Iran and Iraq at war since 1981
  - US skirmished with both countries since 1987
  - Iranian gunboats attacking neutral tankers, USN ships, mining international water ways
  - Iraqi attack on USS Stark in May 1987
    - 2 Exocet anti-ship missiles cripple Stark
    - 37 Americans killed
  - US Intelligence predicts likely attack tomorrow.
  - Aegis deployed early 1988

USS Vincennes

- Ticonderoga-Class cruiser
  - Part of U.S. Navy's 7th fleet
  - Designed for operations in "deep blue" water
- Equipped with Aegis
  - Nicknamed "Robocruiser"
- Normal complement of 358 officers and crew.
- Patrolling the Straight of Hormuz in the Persian Gulf

Aircraft Recognition Test 1: Name that plane

- F-14 “Tomcat”
  - Wing span:
    - 64 feet unswept;
    - 38 feet swept
  - Length: 62 feet 7 inches
  - Height: 16 feet
  - Crew: 2
  - Passengers: None
  - Weapons: Lots
  - In common use by Iranian Air Force (from the days of the Shah)

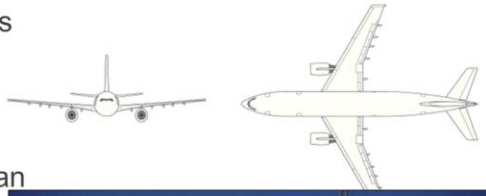


RYERSON UNIVERSITY

School of Computer Science

Aircraft Recognition Test 2: Name that plane

- A300 “Airbus”
  - Wing span: 147 feet 1inch
  - Length: 177 feet 5 inches
  - Height 54 feet 6.5 inches
  - Crew: 2
  - Passengers: Over 250
  - Weapons: None
  - In common use by Iranian airline

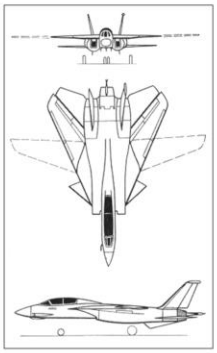


MDM
MASTER OF DIGITAL MEDIA

RYERSON UNIVERSITY

School of Computer Science

Which is which?



MDM
MASTER OF DIGITAL MEDIA

Chronology of Events

- 0633: Capt of USS Vincennes orders “all ahead flank” (without orders from superiors)
  - ship being harassed by gun boats.
- 0840: USS Vincennes is 40 miles north of required position.
- 0845: Capt leaves helicopter behind, which follows gunboats north.
  - Helicopter provides local “eyes”
- 0939: Capt uses ambiguous information as evidence to “open fire” on gunboats.
- 0941: USS Vincennes illegally crosses into Iranian waters

Ambiguity

- 10:47 AM –While Vincennes engaged with Iranian gunboats, "Unknown–Assumed Enemy" appears on radar.
  - Identification Friend or Foe (IFF) shows both COMAIR and MILAIR
- 10:49 AM –Vincennes warns aircraft on military frequency,
  - no response.
- 10:50 AM –Warnings repeated, civilian and military channels,
  - no response.
- 10:51 AM –Aircraft warned will be shot down at 20 nm unless change course,
  - no response.

RYERSON UNIVERSITY

School of Computer Science

Confusion

- 10:51 AM –Vincennes holds fire,
  - confusion about whether descending or climbing.
- 10:53 AM –Final warning,
  - no response.
- 10:54 AM Two SM-2 missiles launched,
- Iranian Airlines Flight 655 is 8 nm away at 13,500 feet

MDM MASTER OF DIGITAL MEDIA

RYERSON UNIVERSITY

School of Computer Science

NBC News Report

MDM
MASTER OF DIGITAL MEDIA

HRI problems

- Memories of USS Stark incident caused expectations within crew
- Operators claimed the incoming aircraft was descending and picking up speed
- Anonymous shouts and warnings contributed to tense atmosphere
- Capt paid more attention to emergency signals than computer displays
- Stress, tension, lack of time, and “fog of war” all contributed to the problem

MDM
MASTER OF DIGITAL MEDIA

RYERSON UNIVERSITY

School of Computer Science

Other Problems

- AEGIS sea trials were unrealistic
  - Initial tests held in New Jersey
- Senior officers knew little about “computerized warfare”
- Operator missed Flight IA655
  - confused by gulf’s four different time zones?
- Responsible officer in CIC had stood watch only twice before and never fully learned routines
  - Pressed the wrong keys 23 times

MDM
MASTER OF DIGITAL MEDIA

CIC: Combat Information Centre