Direct Manipulation and Immersive Environments

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Outline

Introduction

What is direct manipulation

Some examples

2D and 3D interfaces

Teleoperation and presence

Augmented and virtual reality

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Introduction

The central ideas in satisfying interfaces are

- Visibility of the objects and actions of interest
- Rapid, reversible, incremental actions
- And replacement of typed commands by a pointing action

Direct-manipulation ideas are at the heart of many non-desktop interfaces.

Game gloves

Fly drone

Mobile devices

Introduction

New concepts of direct manipulation include

- Virtual reality
- Augmented reality
- Touchable UI

AR   VR   Touchable UI

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What is direct manipulation?

Direct manipulation was introduced in the early days of Xerox PARC.

An example of direct manipulation is driving an automobile.

- You can try to turn a car by typing a command or selecting "turn left 30 degrees" from a menu

Xerox PARC

Driving a car

What is direct manipulation?

The comparison between early designs and current designs
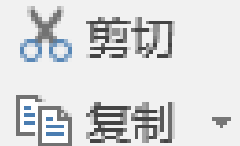
- Word processor
- Power point

What You see Is What You Get (WYSIWYG)

在此处键入公式。
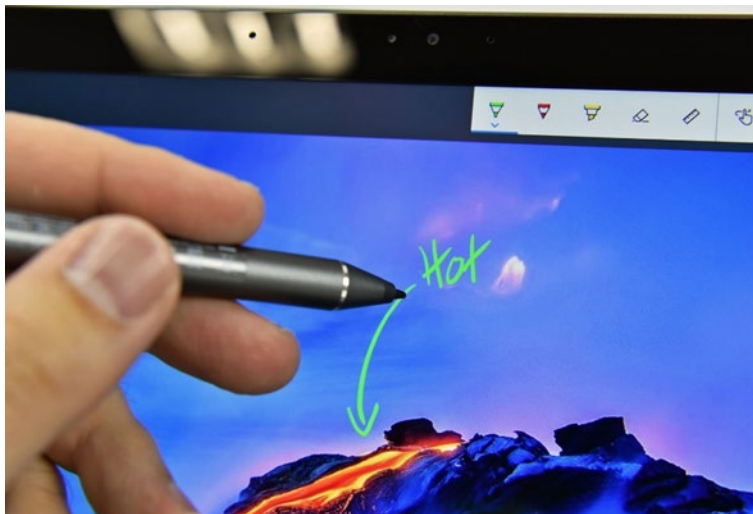
Principles of direct manipulation

Continuous representations of the objects and actions of interests with meaningful visual metaphors

Physical actions or presses of labeled interface objects (i.e. buttons) instead of complex syntax

- :wq and :w in Vim vs ⊟ in Word

Rapid, incremental, reversible actions whose effects on the objects of interest are visible immediately
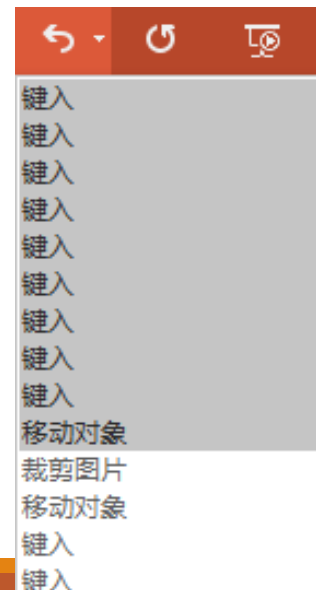
Advantages of direct manipulation

Novices can learn basic functionality quickly

Experts can work rapidly

Knowledgeable intermittent users can retain operational concepts

Error messages are rarely needed
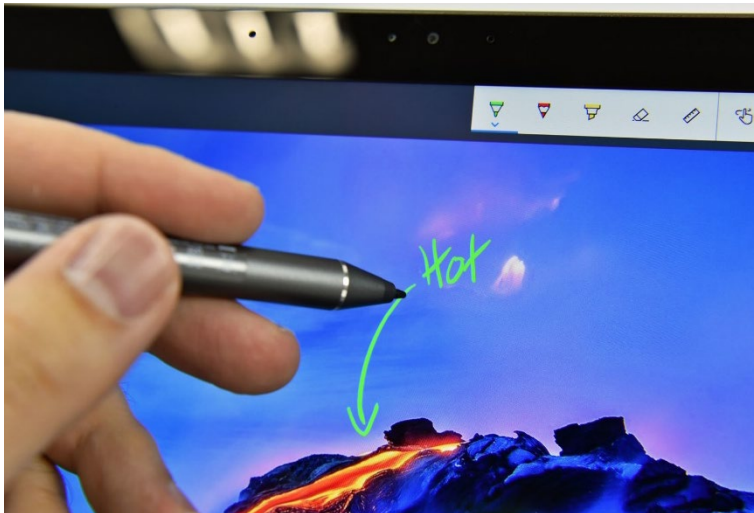
Users an immediately see operation results

Users experience less anxiety

Users gain a sense of confidence and mastery

Translational distances

Choose suitable metaphors to represent actions and objects.

- Using familiar metaphors makes the learning process easier

Translational distances

Translational distance

- Strength of metaphors
- Level of indirectness

Examples of translation distances

- Weak – Early video game controllers
- Medium – touchscreens, multi-touch
- Strong – data glove, gesturing, manipulating tangible objects
- Immersive – virtual reality

Translational distances

Weak direct manipulation

- Basic direct manipulation
- Keyboard, mouse, trackpad, joystick, etc
- Translational difference is large

Mouse

Trackpad

Joystick

# Translational distances

Medium direct manipulation

- Reduce the translational distance
- Users can touch, move, and grabs the entities on the screen
- Touchscreens: mobile, kiosk, and desktop
- Limited by the screen
- Some actions are intuitive, but others should be learned

Translational distances

Strong direct manipulation

- Involves actions with different body parts, e.g. hand, foot, head
- Place hand/foot/head "virtually" inside the physical space
- Users can grasp, throw, drop, manipulate, and so forth
- Limited by the spaces
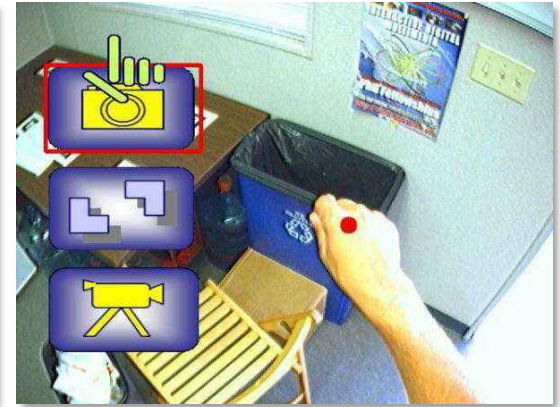
Immersive direct manipulation

- Combined with virtual reality
- The scenery changes when user moves

Problems with direct manipulation

For vision-impaired users, command languages are more suitable than GUI

- But screen readers, speech-enabled devices, page readers, and audio designs can compensate the drawback

Direct manipulation designs may consume valuable screen space

Users must learn the meanings of visual representations and graphic icons

Experienced users prefer typing commands

- Keyboard is more effective than mouse

A finger pointing at a device may partially block the display

Some direct-manipulation principles are difficult to realize

Continuing evolution

A successful direct-manipulation interface must present an appropriate representation or model of reality

Direct Manipulation

Advantages

- Visually presents task concepts
- Allows easy learning
- Allows easy retention
- Allows errors to be avoided
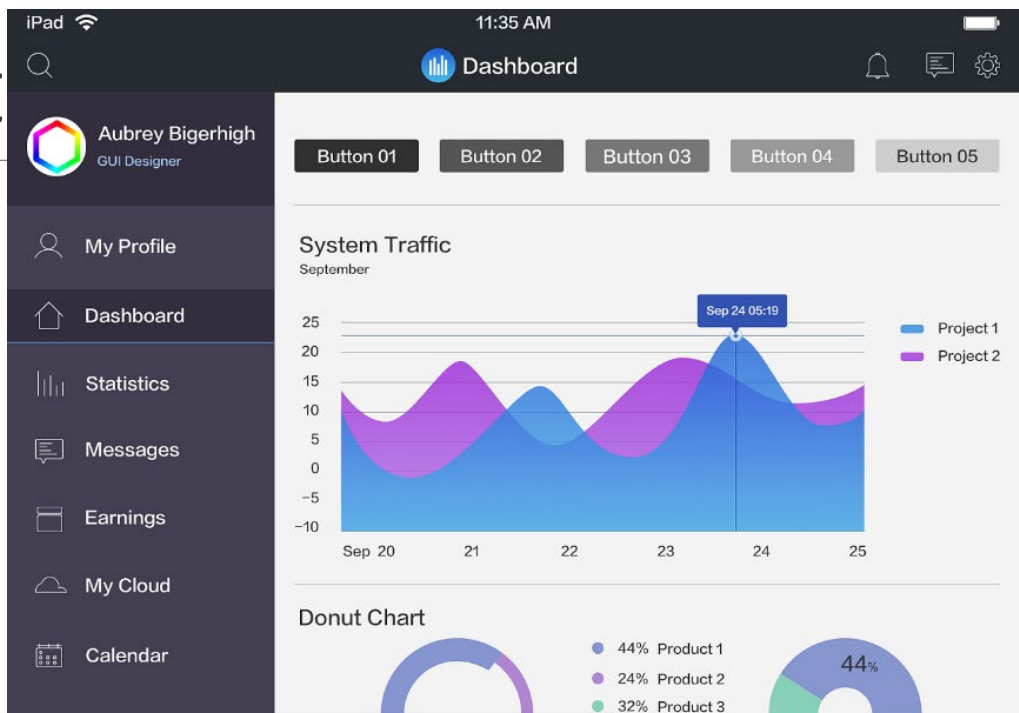- Encourages exploration
- Affords high subjective satisfaction

Disadvantages

- May hard to program
- Accessibility requires special attention

Continuing evolut

Dashboard, Virtual maps

GOAL: Comprehensible interfaces that enable rapid learning, predictable and controllable actions, and appropriate feed-back to confirm progress

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Geographical systems including GPS
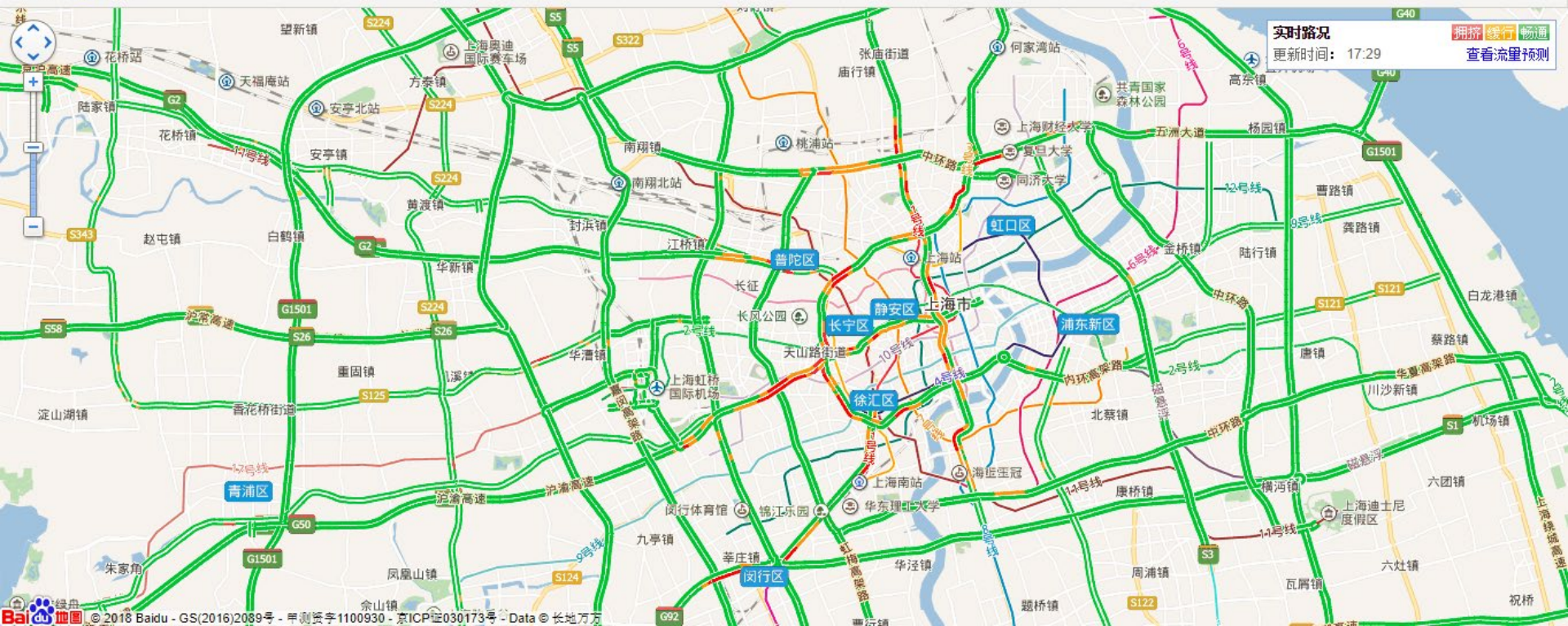
"Where we are?" and "Where we want to go?"

Maps combined aerial photographs, satellite imagery, and other sources
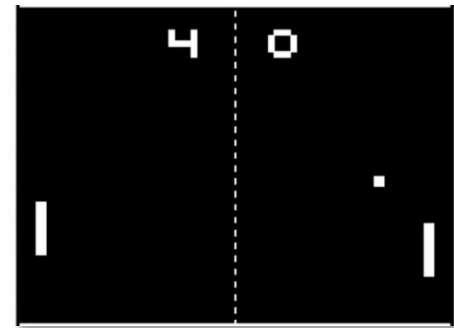
Real-time traffic

Video games

Games have evolved for a long time.

Wii, PlayStation, Xbox 360 → Wii U, PlaySation 4, Xbox One
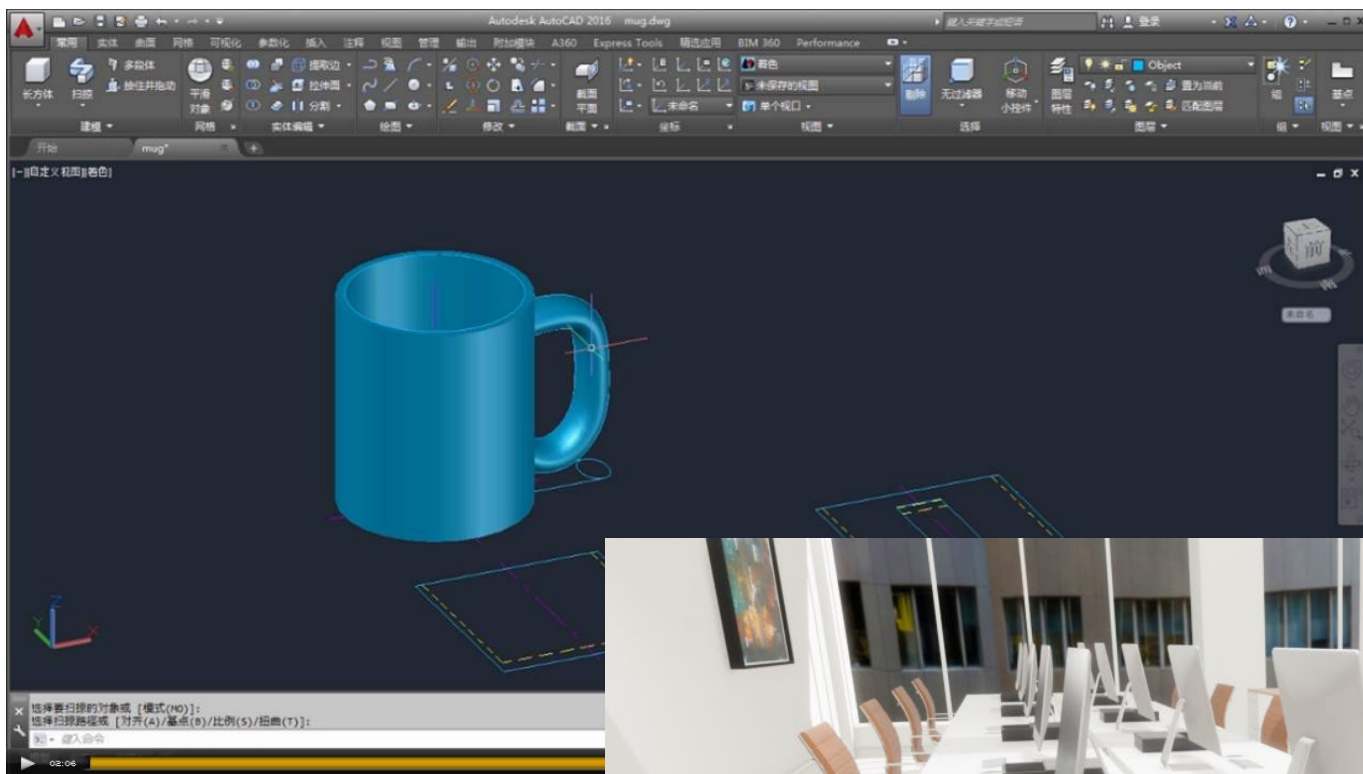
Games combining 3D techniques

Single/multiple players

Video games

Wii, Xbox: *natural* user interface

Computer-aided design and fabrication

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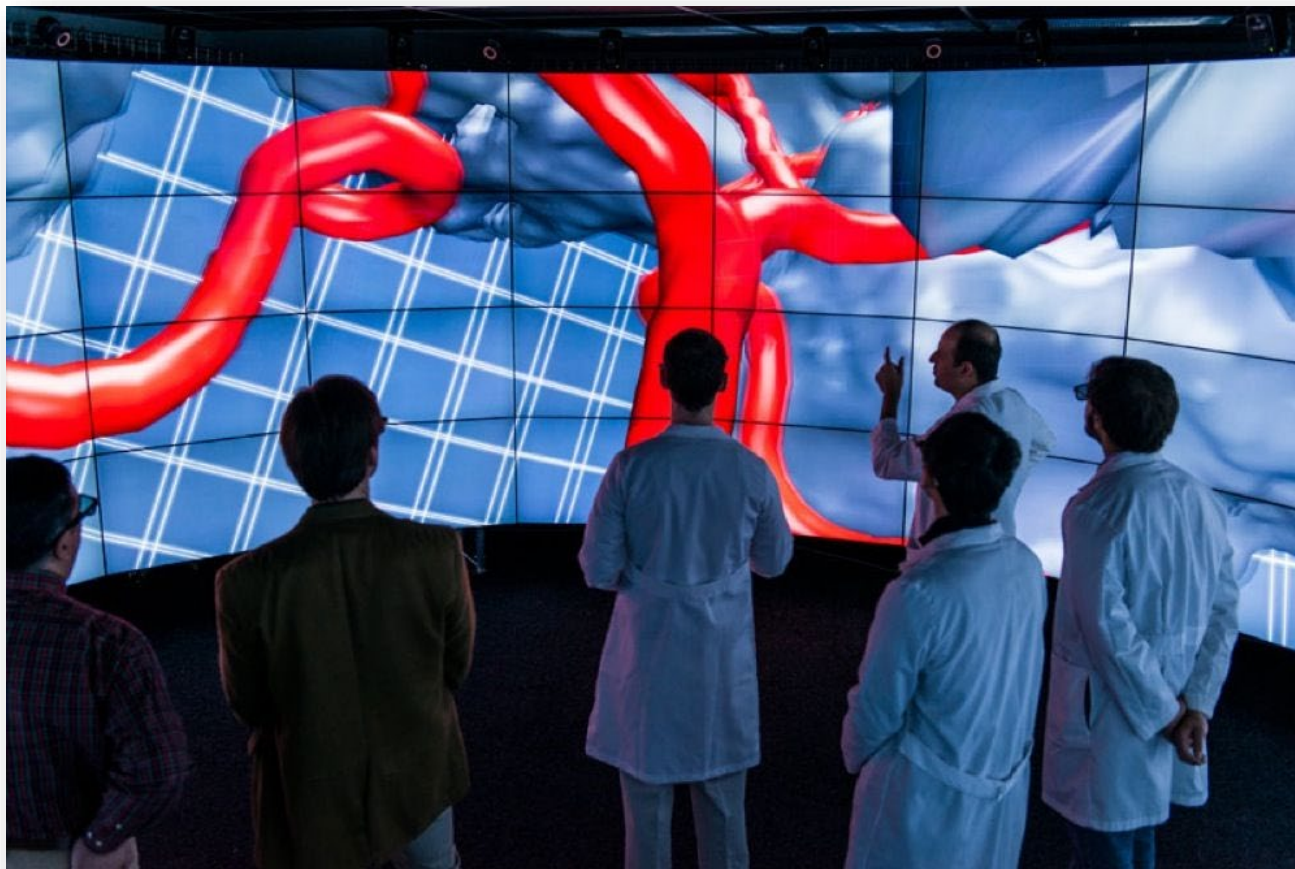
Teleoperation and presence

Augmented and virtual reality

2D and 3D interfaces

3D interfaces are more natural than 2D interfaces

"Enhanced" interfaces improve user experiences
- Flying through objects, multiple simultaneous views of objects...

2D and 3D interfaces

Guidelines for inclusion of enhanced 3D features:

- Provide overviews
- Allow teleportation
- Offer x-ray version vision
- Provide history keeping
- Permit rich user actions on objects
- Enable remote collaboration
- Give users control over explanatory text and let them view details on demand

2D and 3D interfaces

Guidelines for inclusion of enhanced 3D features (Cont.):

- Offer tools to select, mark, and measure
- Implement dynamic queries to rapidly filter out unneeded items
- Support semantic zooming and movement
- Enable landmarks to show themselves even at a distance
- Allow multiple coordinate views
- Develop novel 3D icons to represent concepts

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Teleoperation

Teleoperation/Remote control

Direct manipulation

Process control

Teleoperation

Examples include

- Scientific applications in space, underwater, or in hostile environments
- Drones

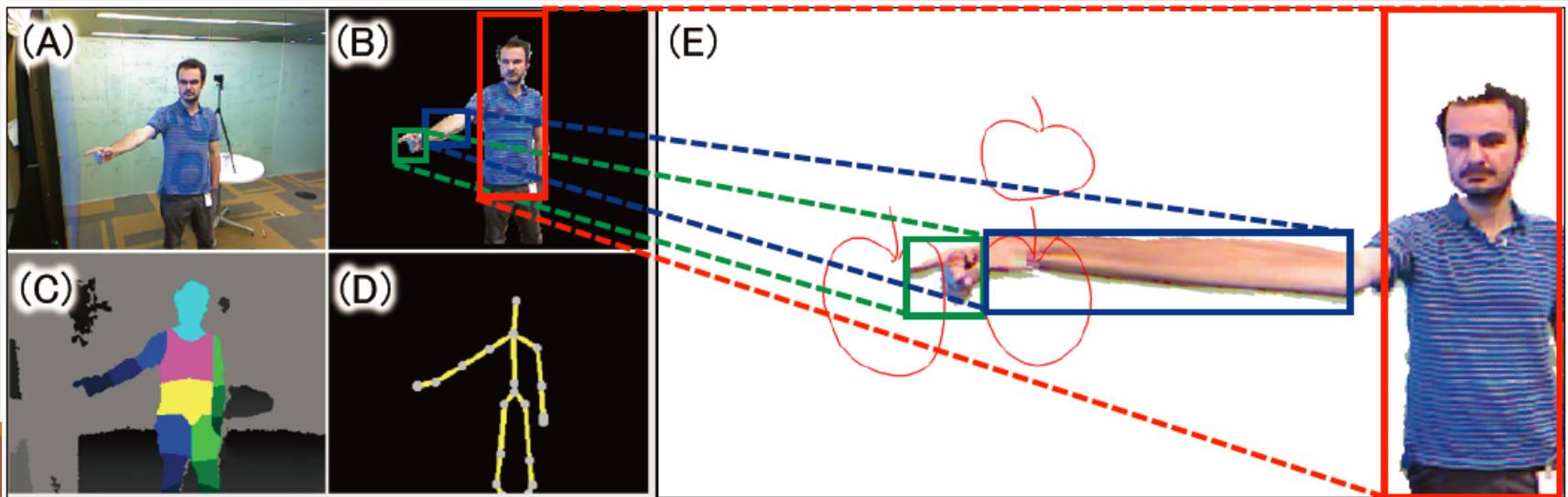Teleoperation is commonly used by the military and by civilian space projects
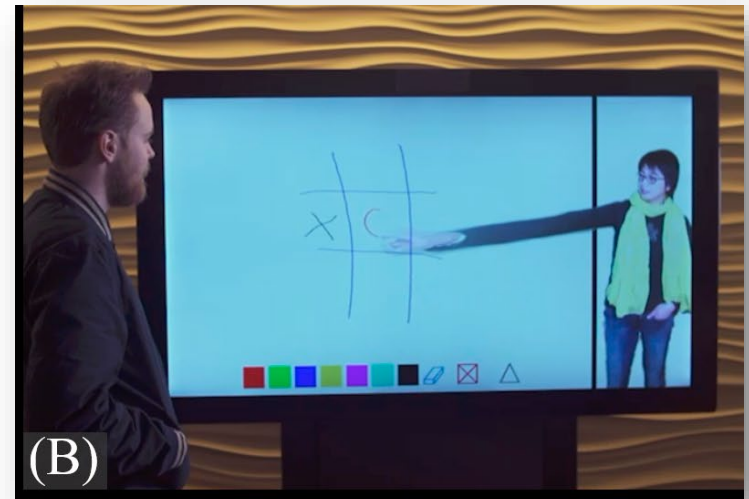
Teleoperation

Factors affect remote environments

- Time delays
- Incomplete feedback
- Unanticipated interferences

Telepresence

ImmerseBoard allows two users to be co-located and work on the same shared screen

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AR/VR

Virtual reality breaks the physical limitations of space and allow users to act as though they were somewhere else

Augmented reality shows the real world with an overlay of additional overlay

Situational awareness shows information about the real world that surrounds you by tracking your movements in a computer model

Augmented reality is an important variant

- Enables users to see the real world with an overlay of additional interaction.

Augmented reality

Using augmented reality overlays, various points of interest can be shown on a mobile phone

Icons represent the type of place (food, shopping, etc.) and distances from the current location
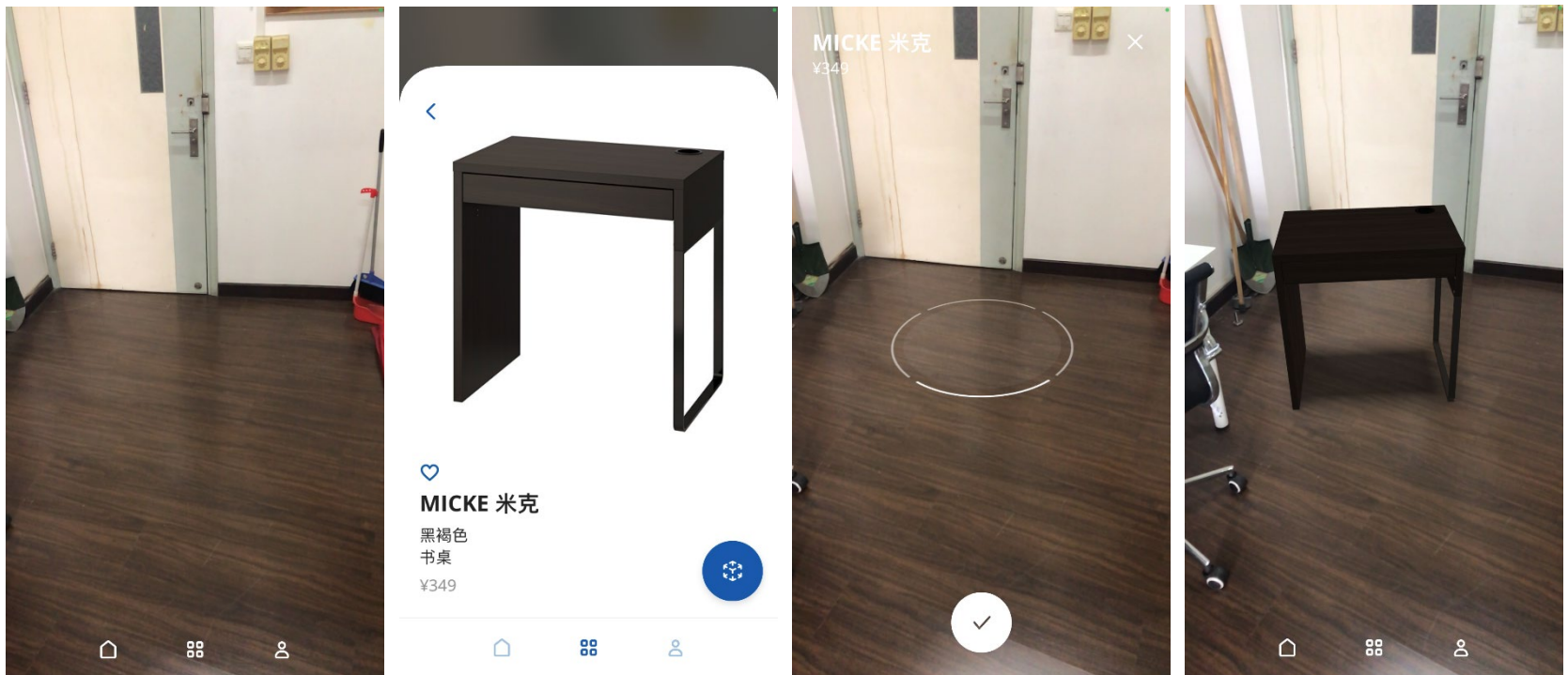
Links are provided to user reviews

Augmented reality

Customers can use their personal mobile devices to pull up objects from the IKEA Catalog and see how the various items would look in their own house (Apple Store: IKEA Place)

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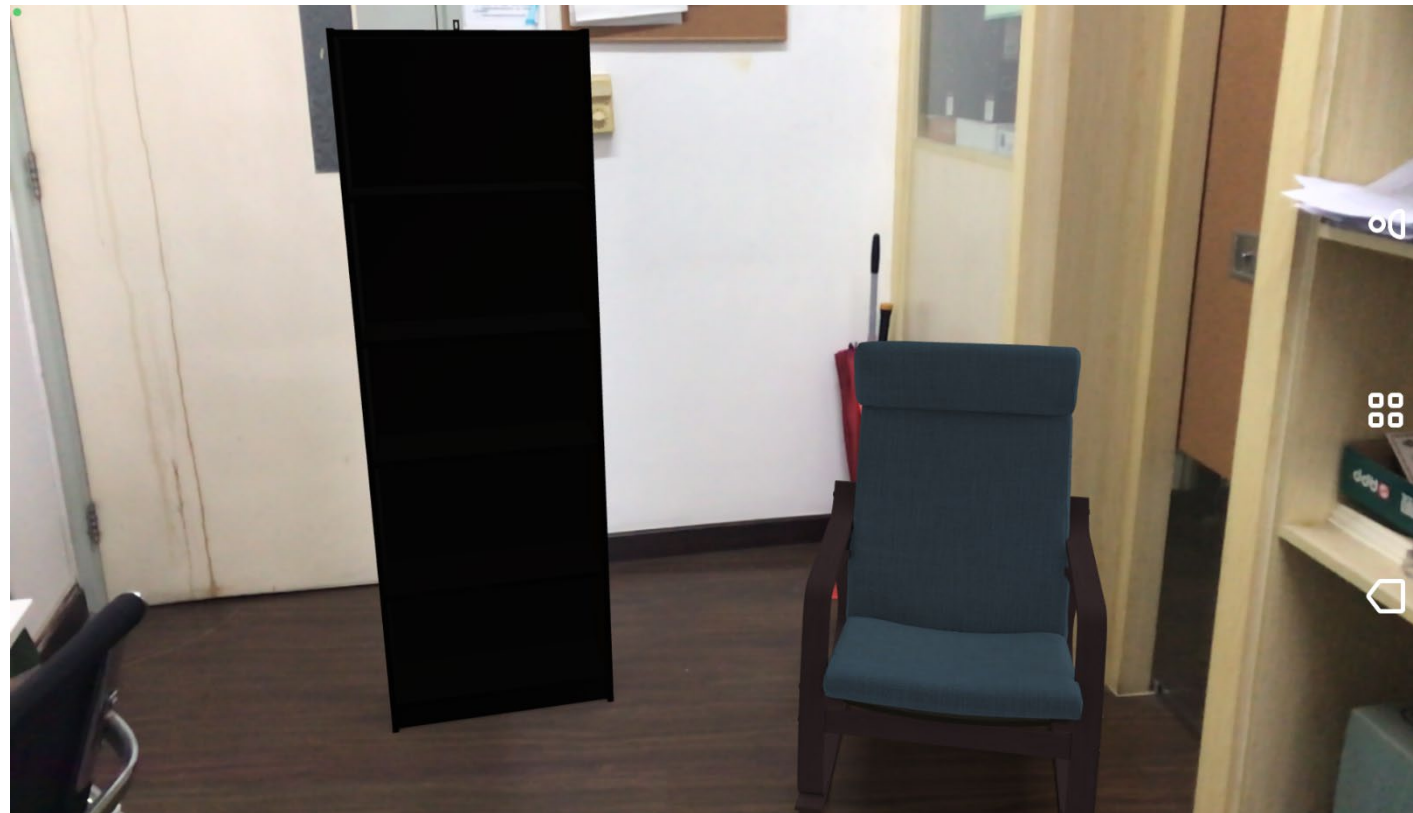
Virtual reality

Image of a virtual meditative world that users can use for engaging in meditation activities

- The virtual world has sounds
- They change with each chakra (stage) of the meditation process
- This is an application of positive computing

CAVE

Cave automatic virtual environment