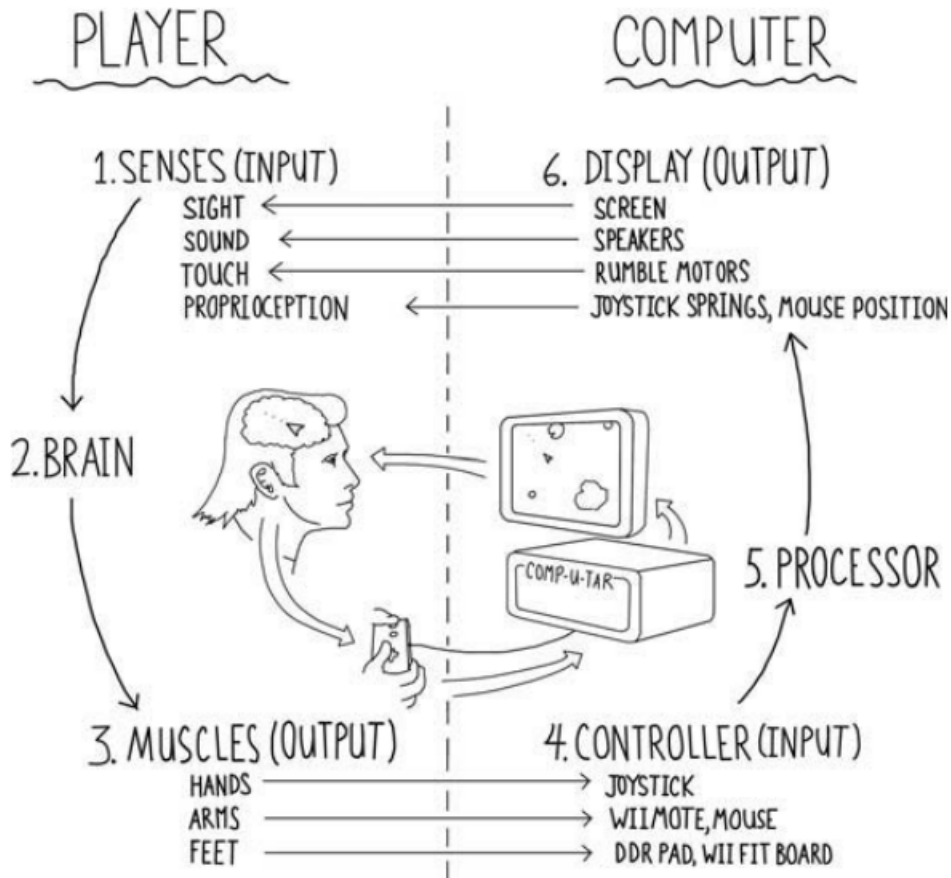


Lecture3 Game Feel and Human Perception

1. When and How does Real-Time Control Exist

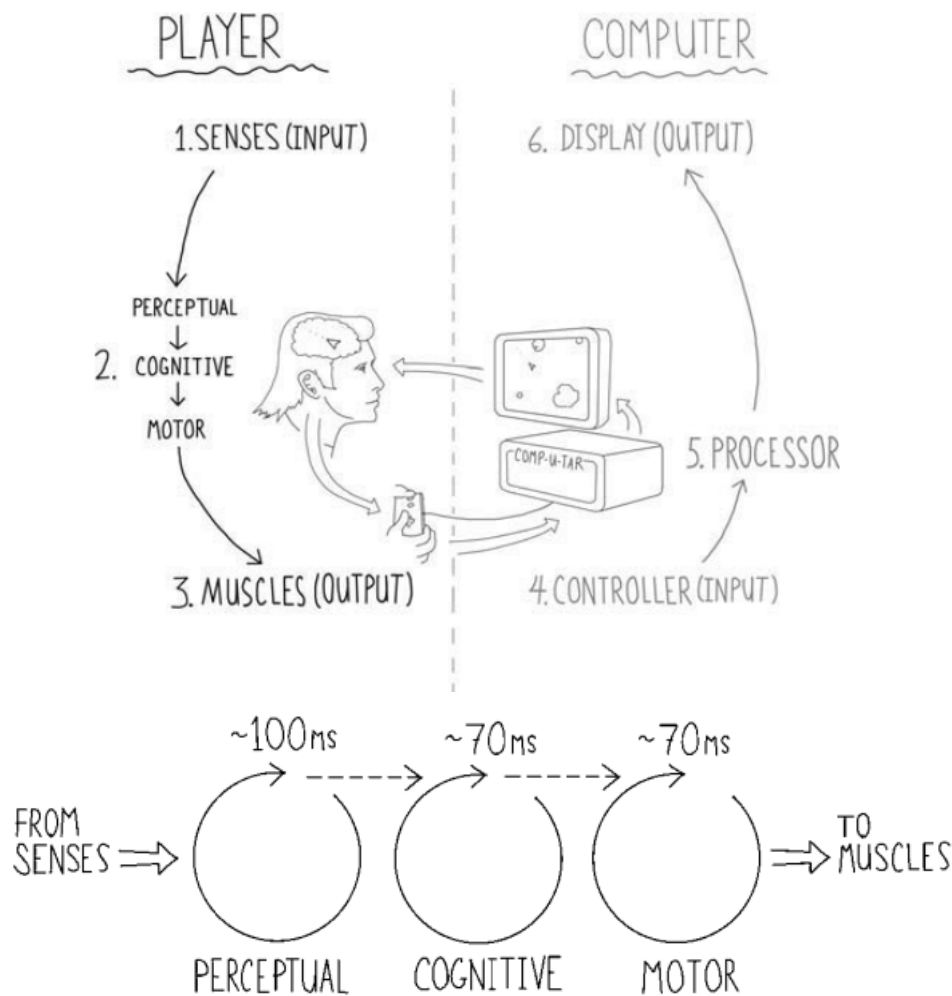


To sustain real-time control

- computer
 - display images at a rate greater than 10 per second
 - respond to input within 240 ms
 - accept input and provide response at a consistent, ongoing rate of 100ms or less
- player
 - the minimum amount of time takes for a person to perceive the world is around 240 ms

2. The Human Side of Things

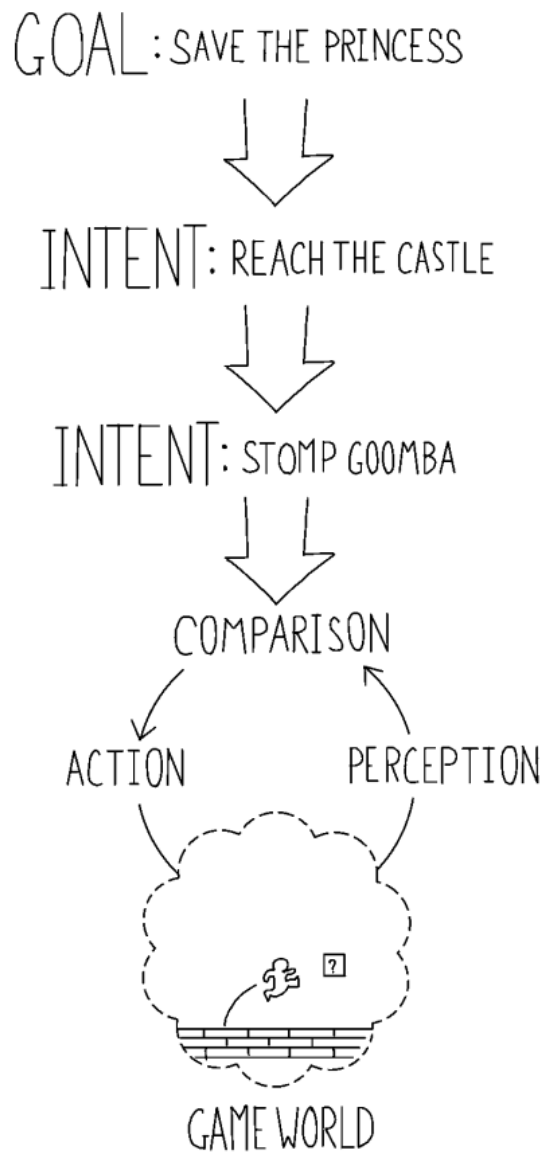
Feed Back Loop: Three Processors



- **240 = Perceptual + Cognitive + Motor**
 - **Perceptual:** ~100 ms [50–200ms]
 - takes the input from the senses and makes sense of it, looking for patterns, relationships and generalizations
 - **Cognitive:** ~70 ms [30–100ms]
 - compares intended result to the current state of things and decides what to do next
 - **Motor:** ~70ms [25–170ms]
 - receives the intended action and instructs the muscles to execute it

Correction Cycle

In a video game, real-time control is an ongoing process where high-order intentions trickle down and become individual, moment-to-moment actions



These actions are a part of an ongoing correction cycle, where

- the player perceives the state of the game world
- contemplates it in some way
- formulates an action intended to bring the game state closer to an internalized ideal

Fitt's Law

Accurately predict how quickly you can move your hand to a target of a particular size at a certain distance

$$MT = a + b \log_2 \left(\frac{D}{W} + 1 \right)$$

- MT : movement time
- a : start/stop time of the device
- b : speed of the device
- D : distance from starting point to target
- W : width of target measured along the axis of motion

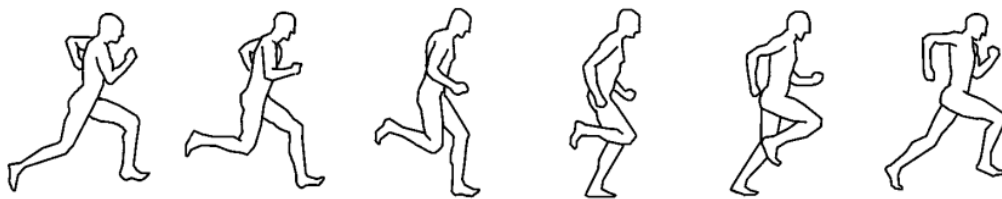
3. The Computer Side of Things

Real-time control relies on the computer sustaining three thresholds

1. **Impression of motion:** ≥ 10 fps
 - the impression will be better and smoother at 20 or 30 frames per second
2. **Instantaneous response:** input to display happens ≤ 240 ms
3. **Continuity of response:** cycle time for the computer's half of the process ≤ 100 ms

Impression of Motion

A single object in motion is represented by a series of static images



Instantaneous Response

The impression of causality

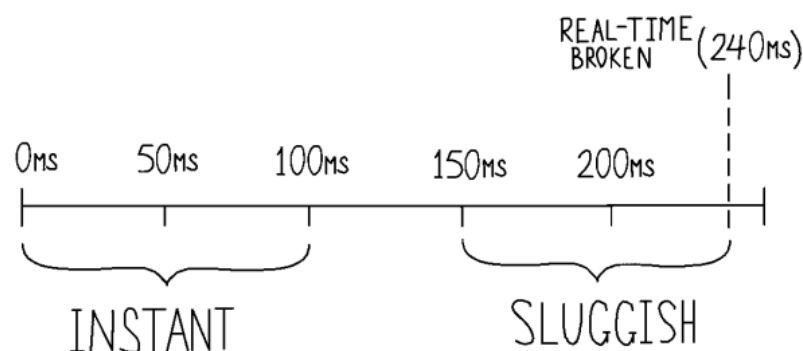
- If I move a mouse and the cursor seems to react immediately, I tend to assume that effect was caused by my action

Perceptual fusion also gives an upper bound on good computer response time. If a computer responds to a user's action within [100ms], its response feels instantaneous with the action itself. Systems with that kind of response time tend to feel like extensions of the user's body

Response lag

Response lag is the delay between the player triggering an event and the player getting feedback (usually visual) that the event has occurred

If the delay is too long, then the game will feel unresponsive



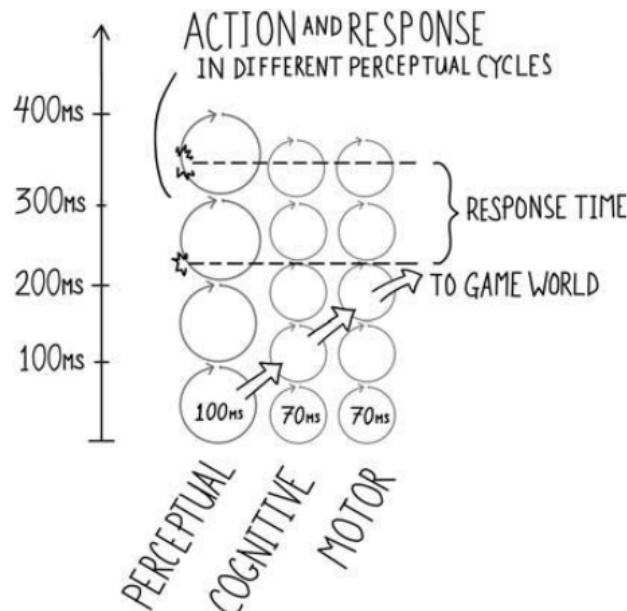
- 50 - 100ms: tight and responsive to players
- 150ms+: sluggish

There is not exact point where the response lag can be said from tight to sluggish. Other factors such as mapping and polish effects can shape this impression of responsiveness

But there is a threshold above which the sensation of real-time control is broken: **240ms**

Continuity

The game needs to update faster than the player's perceptual processor is running



4. Implication of Perception

Perception requires action

In order to perceive something, you have to see it in action

it accurately describes the sensation of exploring and learning your way around an unfamiliar game space

Humans are adept at learning the physical properties of a new and unfamiliar object and do it very quickly

Perception is skill

If perception requires action, that action must be learned.

Perception is to a large extent an acquired bodily skill that is shaped by all our interactions with the world

Perceptual field is your world; your structural understanding of everything you perceive around you and its meaning

People are going to figure out everything about your world either way—our physical reality is much more complex and nuanced than any game world, and we've got years of experience at perceiving it—better to make it simple and self-consistent than a broad inchoate mess

If an action is unpracticed and requires conscious thought and effort, it is an abstract movement. If it's so practiced that it happens automatically and without conscious thought—a pure translation of intent into action—then it's considered a concrete movement.

Perception includes thoughts, dreams, generalizations and misconceptions

Perceptual field compasses attitudes and ideas

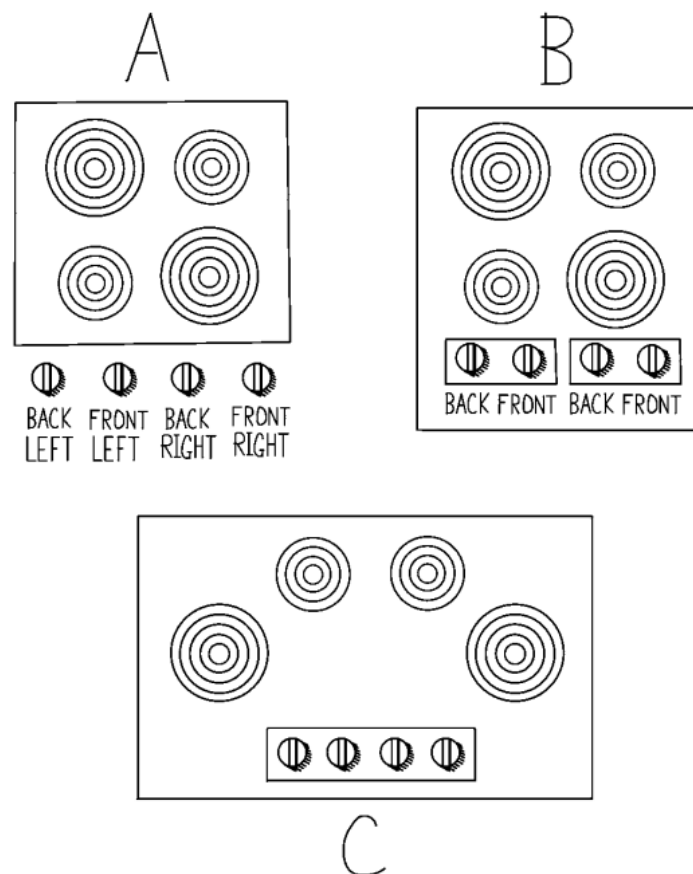
Perceptual field incorporates not only the system image, but the thoughts, ideas, feelings and generalizations about the system that players have brought with them, and is constantly forming and reforming, is a much more effective for understanding that experience.

Design model

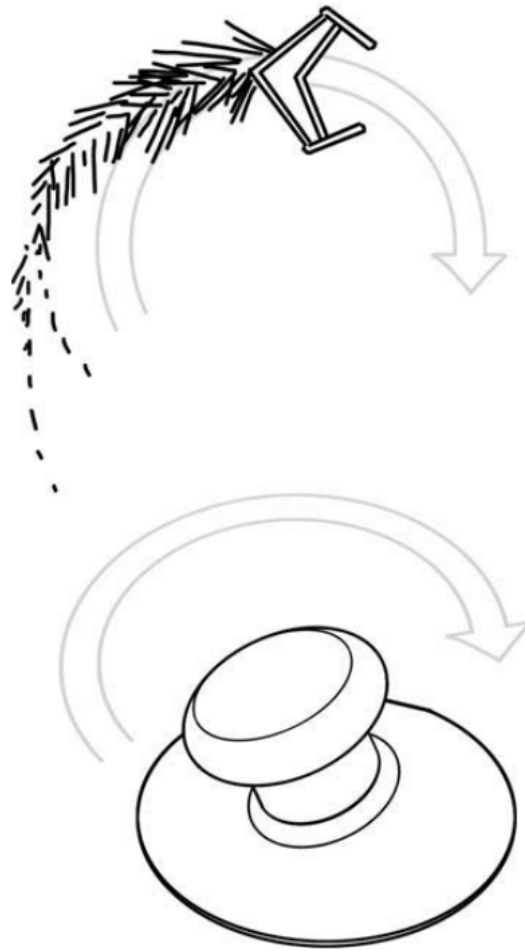
The way the designer imagined the user would interpret the system

It helps greatly in designing what players refer to as intuitive controls

Examples



- Stove C makes more sense than A and B and is far easier to operate because it is a clear, spatial correlation between the position of the knobs and the position of the burners they operate



- the movement of the thumbstick corresponds very obviously to the motion of the little ship in the game

Perception is a whole-body experience

Eyes, ears, tactile sense, proprioception — there is no separation when a person perceives something

Don't think of each kind of stimuli as somehow separate, but as an integrated part of perception

- a combination of visuals, sounds, proprioceptive sensations (from the position of the fingers on the controller or whatever) and tactile sensations (from controller rumble or haptic feedback) become a single experience in a game

A game world substitutes its own stimuli for those normally created by interacting with the real world, but the experience of perception is much the same

The experience of perception of real-life phenomenon never has inconsistencies across stimuli so the brain has a hard time ignoring them when they happen in a video game

Tools become extensions of our bodies

When we interact with the world, we perceive our bodies in two ways

- as part of our self
- as one object among the many objects of the external, objective world

It is important to notice that learning a new skill also changes the body space

A video game has its own model of reality, internal to itself and separate from the player's external reality

- the player's bodily space
- the avatar's bodily space.

Action in the game world can only be explored through the virtual bodily space of the avatar. Players extend their perceptual field into the game, encompassing the available actions of the avatar

5. Summary

How does real-time control exist

- human side
 - perceptual
 - cognitive
 - motor
- computer
 - impression of motion
 - perceived instantaneous response
 - continuity of response

Implications of human perception

- Perception requires action
- Perception is a whole-body phenomenon
- Perception is an effortless fusion of visual, aural, tactile and proprioceptive stimulus
- Perception is an ongoing process of skill-building
- Perception can be extended to tools