Why Humanoid Robots Shouldn't Always Respond Instantly

By Katherine Lee

Introduction

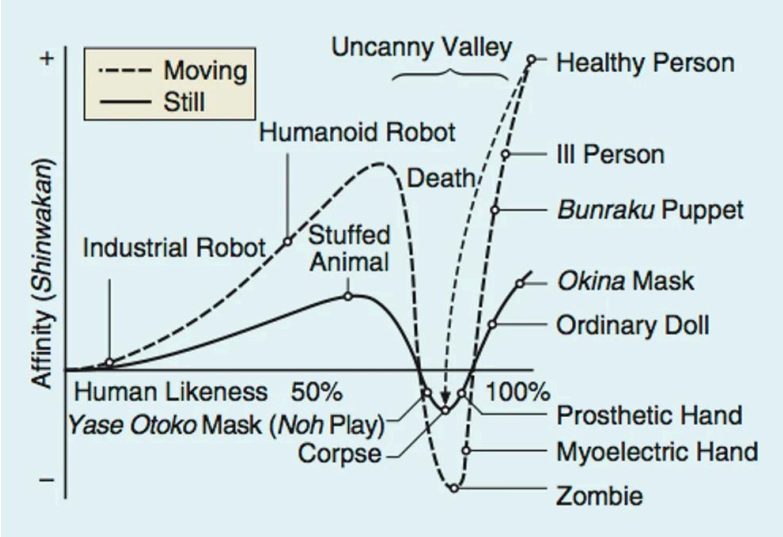
As humanoid robots become embedded in everyday lives and workflows, instant response should not always be the design goal. Attempting to mask latency with instant feedback can make human to robot interactions feel uncanny or misleading. By designing intentional delay such as brief anticipation cues before acting or speaking, designers can make system behavior more clear and communicative, and support user trust and adaptation over time.

The Design Challenge: Understanding Latency & Uncanny Valley

In the interaction between humans and machines, the absence of immediate feedback often transforms a brief pause into a moment of user confusion. This waiting period is known as latency, which measures the time between input and response in the system. Although latency can vary by the complexity of the task or system you are working with, delays exceeding one second can cause feelings of unproductivity or irritation (Miller, 1968). In modern contexts, however, thresholds have evolved; for instance, in AI-driven systems like chatbots, users tolerate slightly longer pauses if they mimic thoughtful human processing, as seen in studies on conversational interactions. (Effects of Response Delay on Perceived Naturalness, 2025).

Our emphasis on immediate feedback, driven by expectations of efficiency, has pushed technological systems to prioritize speed as a primary measure of success, accelerating development cycles, and minimizing tolerance for delay. However when interacting with anthropomorphic objects, especially robots that will continuously develop to look and act more human, user experience design and understanding user needs through interactions or tangible interfaces is a necessity to create pleasant user experience.

With the mismatch of a robot's looks which looks human but acts unnaturally, we can feel uneasy. The Uncanny Valley, a concept coined by robotics professor Masahiro Mori at the Tokyo Institute of Technology in 1970, describes the sharp drop in emotional affinity people feel toward human-like figures that appear almost, but not quite, human. As human resemblance increases, familiarity generally rises—until it reaches this "valley," where we feel unsettled. This concept has been gaining attention as technology evolves and researchers build robots that act and look increasingly human.



Uncanny Valley Diagram (Source: https://spectrum.ieee.org/the-uncanny-valley)

Intentional Latency as a Design Tool

Designing intentional social latency, like the rules of human interaction, such as pauses in verbal or physical cues that are long enough to feel smooth, but short enough to feel natural, can increase our affinity towards humanoid robots.

While designing my first autonomous lamp 'robot'--Nostalgorithms--every time the servos started to rotate, sudden jerking movements sometimes startled me. I soon realized that this is because robots act in a monotonic manner, but humans do not, such as our arms naturally slowing down when drawing curves or tight circles and speeding up on straight lines, also known as the Two-Thirds power Law. As a result, movements in robots are mathematically "perfect" but biologically impossible. The uncanny valley effect can only intensify with humanoid robots that almost look human, but have choppy mechanical movements.

In the book Illusions of Life (1981) by Frank Thomas and Ollie Johnston, a widely known book in the field of animation, explains the twelve basic principles of animation that made beloved Disney characters feel alive. One of them was anticipation, which meant preceding each major action with a planned sequence of actions, such as change of expression, that lead clearly from one activity to the next to help the audience understand the events on the screen. Without anticipation, the audience can feel sudden surprise or be caught off guard when something entirely different happens without warning. Just like movements portrayed in animation, robotic movements can be eased-in and eased-out or even have 'micro-movements' to express that the system is thinking and is alive.

In some cases, industrial workflows such as robots at a warehouse, speed is everything. In *everyday* workflows where robots are highly likely to interact with humans at home, office, care, social awareness is more important than raw speed. For example, in shared tasks such as a

robot handing you a tool in a workshop, a very brief pause to "check" the environment can increase user trust because it can signal that the robot is being cautious or thoughtful.

Conclusion: Design as the Bridge Between

The drive for immediate feedback has historically prioritized efficiency as the ultimate metric of technological success. However, as we transition from static tools to anthropomorphic partners, we must recognize that raw speed often comes at the expense of human comfort. As robots advance, as shown by 2025's humanoid breakthroughs, intentional latency can transform them from tools into trusted partners.

Looking toward a future where humans and robots coexist in shared spaces, our role as designers is to serve as the bridge between mechanical capability and user expectation, where "perfect" mathematical movement is tempered by biological realism. In the breakthroughs of the coming years, the success of human to robot interaction will not be measured by how fast a robot responds, but by how clearly it communicates its intent. As an industrial designer interested in working with emerging technology that involve physical and digital interfaces, this means design is not simply about form and function, but timing, behavioral clarity, and building trust in interactions.