Research and inspirations

Human-Computer Interaction:

Whilst the concept of HCI has been around since the 1980s[1], it is only within the last 20 years that plants have been utilised as an 'object'; much like a keyboard or mouse.[2] Through this project, we will be exploring how HCI and plants can be incorporated to create interactive exhibitions.

Biomodd Installation at Regeneration Movement, 2016 by The National Taiwan Museum of Fine Arts[3]

For the first example, I have chosen Biomodd, a project that has been running since 2007. It began during Angelo Vermeulen's residency at Ohio University's College of Fine Arts. Since then, it has travelled the world reaching 5 continents so far (Europe, Asia, North America, South America and Oceania). One interesting feature is the way E-waste is utilised. The participants take apart and rebuild discarded computers, creating a new network where users can play a game. This effectively forms a symbiotic relationship, by utilising the heat produced by the computer components, the environmental conditions that the plants need to survive are created. I liked the way that every single aspect of this project was connected, especially when they changed how nature works; instead of relying on the environment, the computers were providing the plants with life instead. Whereas in everyday life, it is often computers that are taking from the environment. Such as in large data centres, where excessive amounts of water are used to cool down the devices. Google reported that 15% of the water they

[1] Carroll, J.M. (no date) Human Computer Interaction - brief intro, The Interaction Design Foundation. Available at: https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/human-computer-interaction-brief-intro (Accessed: February 19th, 2025).

[2] (No date b) Sciencedirect.com. Available at: https://www.sciencedirect.com/science/article/pii/S1071581923001374#abs0002 (Accessed: February 19th, 2025).

[3] SEADS (no date) Seads.network. Available at: https://seads.network/project/tai8 (Accessed: February 19th, 2025).

consume comes from areas with “high water scarcity”.[4] So this project gives back rather than just taking away.

Akousmaflore, ISEA 2009 / Ormeau Baths Gallery - Belfast (Ireland)[5]

This installation was created by the artist team Scenocosme (Grégory Lasserre & Anaïs Met Den Act), it has travelled all over the world, but unlike the example above, nothing fundamental to it changes between the visits. Only the location it is being hosted at and the conditions of that environment. Due to the electrostatic energy produced by the user’s body, every time they touch the plant, a sound is produced. Resulting in a unique combination of sounds, creating an experience completely dependent on the user’s actions at that moment.[6] It was interesting that they chose sound as their outcome, as generally plants are only interacted with through sight, scent and touch. By changing it to an auditory experience, the entire way you perceive the plants changes.

[4] Barratt, L., Witherspoon, A. and Uteuova, A. (2025) “Revealed: Big tech’s new datacentres will take water from the world’s driest areas,” The guardian, 9 April. Available at: https://www.theguardian.com/environment/2025/apr/09/big-tech-datacentres-water (Accessed: May 10, 2025).

[5] Lasserre, S.:. G. and den Ancxt, A.M. (no date) Akousmaflore Sensitive and interactive musical plants from scenocosme, scenocosme : Gregory Lasserre & Anais met den Ancxt. Available at: https://www.scenocosme.com/akousmaflore_en.htm (Accessed: March 3rd, 2025).

[6] (No date c) Scenocosme.com. Available at: https://www.scenocosme.com/PDF/akousmaflore_en.pdf (Accessed: March 3rd, 2025).

Christa Sommerer and Laurent Mignonneau, Eau de Jardin. Interactive installation. 2004[7] | Claude Monet[8]

The artists drew inspiration directly from Monet's piece, 'The Water Lilies'[9] and replicated the panoramic composition into this piece of work. However, instead of a painting, they installed a screen with a dynamic scene on it. When the user moves towards or touches the plants hanging from the ceiling, the interaction triggers the scene on the screen to change.[10] Like with Akousmaflore, the outcome is dependent on the visitor's actions. Unlike my first inspiration, I liked the fact that the user directly interacted with the plants rather than a digital interface. This creates more interest because of its dynamic and visual nature. Additionally, you can see the changes in real time, whereas with Biomodd, you are only sustaining the plant's habitat. Even if the computers don't generate enough heat, you will not see the effects on the plants for another few days.

Bionics:

This project draws inspiration from natural fungal communication networks, biomimicry, and interactive installations. The goal is to simulate how plants and fungi exchange information through an artificial root system, allowing users to visualise and interact with these hidden biological processes.

[7] Eau de Jardin (2021) DAM MUSEUM. Available at: https://dam.org/museum/artists_ui/artists/sommerer-mignonneau/eau-de-jardin/ (Accessed: March 3rd, 2025).

[8] The water lilies by Claude Monet (no date) Musee-orangerie.fr. Available at: https://www.musee-orangerie.fr/en/node/197502 (Accessed: May 11, 2025).

[9] The water lilies by Claude Monet (no date) Musee-orangerie.fr. Available at: https://www.musee-orangerie.fr/en/node/197502 (Accessed: May 11, 2025)

[10] Schneider, M. (no date) EauDeJardin ©2004, Laurent Mignonneau & Christa Sommerer, Ufg.ac.at. Available at: https://www.interface.ufg.ac.at/christa-laurent/EauDeJardin.html (Accessed: May 11, 2025).

Cyborg Botany, developed by the MIT Media Lab, explores how plants can function as interactive interfaces by embedding sensors and electronic circuits into living organisms. This project demonstrates how plants can act as biohybrid systems that respond to environmental changes and human interaction. Cyborg Botany informs our project by showcasing the potential for plants to serve as organic input and output devices, reinforcing the idea that fungi and plants could transmit messages visually and kinetically in an interactive installation. The integration of sensors and actuators aligns with our goal of enabling user-driven plant responses, bridging biological and technological interactions.[11]

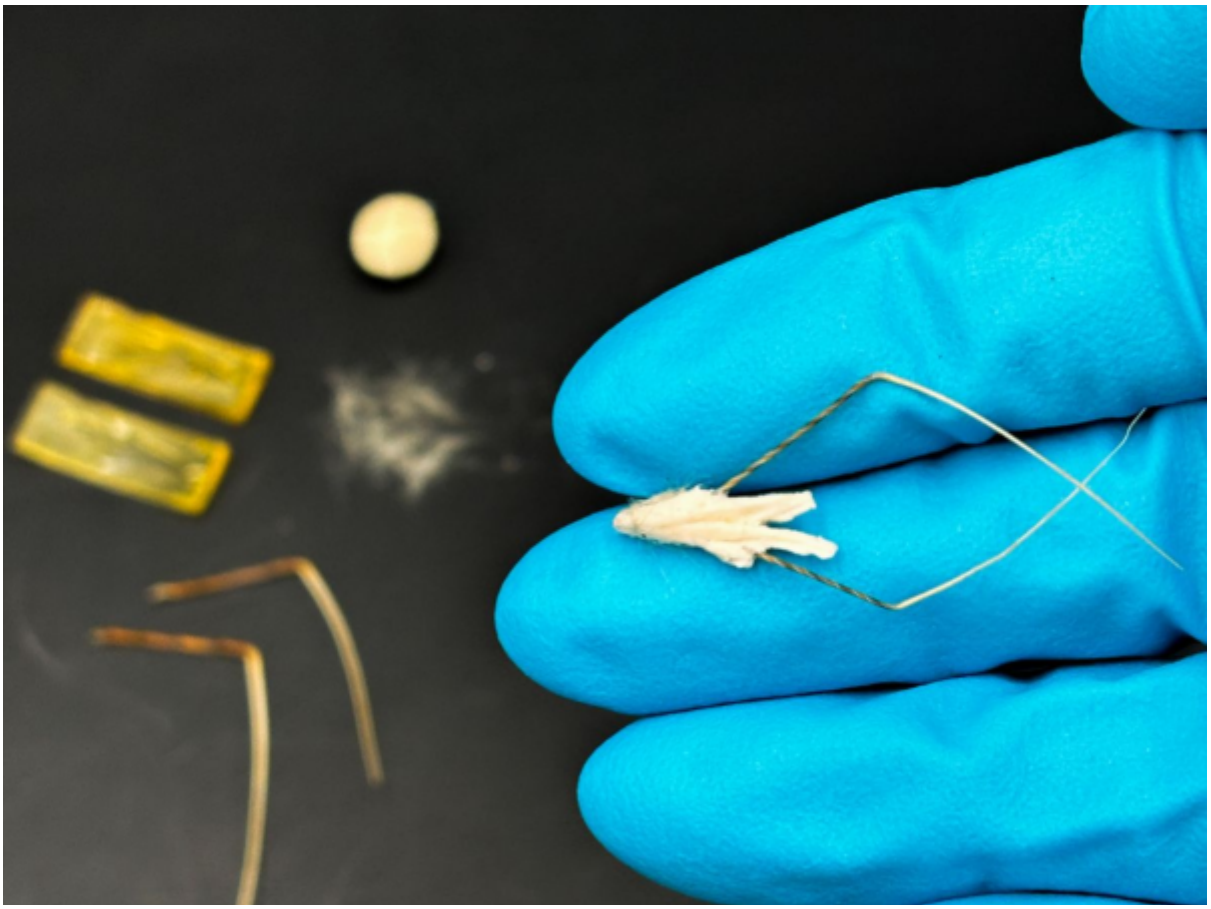
[11] Cyborg Botany: Augmented plants as sensors, displays, and actuators (no date) MIT Media Lab. Available at: https://www.media.mit.edu/projects/cyborg-botany/overview/ (Accessed: April 28, 2025).

Plantoid[12], a robotic project funded by the European Research Council, draws inspiration from plant root structures to develop artificial growth and exploration mechanisms. The project focuses on decentralized intelligence, where robotic roots expand and navigate their surroundings independently. This concept parallels our use of mycelium as a natural network that transmits information among interconnected organisms. Plantoid influences the project's approach to movement and responsiveness, suggesting that artificial roots could react dynamically based on user input, enhancing the simulation of plant-fungal communication.

[12] PLANTOID: Robotic solutions inspired by plants (no date) Shaping Europe's digital future. Available at: https://digital-strategy.ec.europa.eu/en/news/plantoid-robotic-solutions-inspired-plants [Accessed: 9th February 2025]

Flora Robotica [13]investigates plant-robot symbiosis, where living plants and robotic structures co-evolve by influencing each other's growth patterns. This research is relevant to our project because it highlights the potential for biological systems to integrate with artificial elements, forming a hybrid organism that exhibits emergent behaviors. The concept of responsive, self-organizing networks aligns with the mycelium-based signaling system we aim to simulate. Additionally, Flora Robotica emphasizes long-term adaptability, which could inspire iterative improvements in our project's networked responses.

[13] Flora Robotica, 2016. *Flora Robotica: Plant-robot hybrid system*. [online] Available at: https://www.florarobotica.eu/]. [Accessed: 9th February 2025]



The IIT's biohybrid robot[14], constructed from biodegradable materials like flour and oat bran, demonstrates an environmentally sustainable approach to robotics. This project influences our material selection by encouraging the use of organic and biodegradable elements where possible. The integration of soft robotics with natural materials reinforces the idea that artificial plants and fungi should not only simulate biological functions but also embody principles of sustainability.

DARPA's Engineered Adaptation (EA)[15] is another research that explores biohybrid and bioengineered organisms for adaptive environmental response. The principles behind adaptive biohybrid intelligence, as studied in this project, relate to how our installation simulates the intelligent, decentralized decision-making processes of mycelial

[14] stituto Italiano di Tecnologia (IIT), 2023. *Flour and oats for the biohybrid robot: Useful for reforestation*. OpenTalk. [online] Available at: https://opentalk.iit.it/en/flour-and-oats-for-the-biohybrid-robot-useful-for-reforestation/ . [Accessed: 9th February 2025]

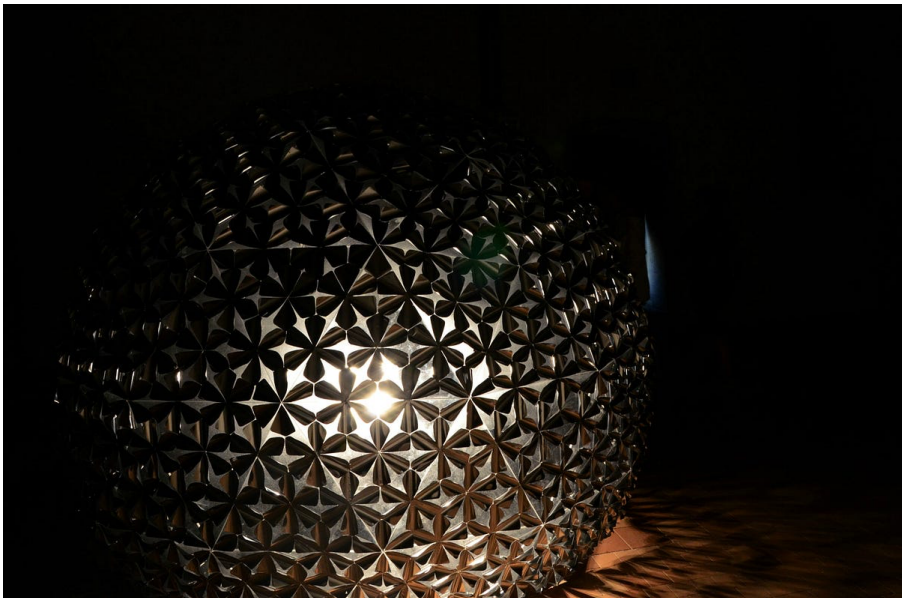
[15] DARPA, 2022. *Engineered Adaptation (EA) Program Overview*. Defense Advanced Research Projects Agency. [online] Available at: https://www.darpa.mil/program/engineered-adaptation . [Accessed: 9th February 2025]

networks. Understanding how living systems process and react to information informs our approach to creating an interactive, responsive installation.

Biohybrid Futures[16], a UK research initiative, also investigates the intersection of synthetic biology, robotics, and human interaction. This initiative aligns with our project's goal of exploring human engagement with organic and artificial intelligence. By studying how users interact with biohybrid entities, we can refine the user experience of our installation, ensuring intuitive and meaningful interactions.

Networks:

Whilst the concept of network systems has existed for decades, it is only in more recent years that artists and designers have begun to draw inspiration from biological and ecological networks, such as mycelium, plant root systems, and distributed fungal communication to inform interactive installations. Through this project, we will be exploring how plant-inspired networks can be reimagined as systems of signal transmission, creating responsive environments where messages travel across a network of mechanical flowers, mimicking the decentralized logic found in nature.



Art Stories (2019) *Studio Roosegaarde's Lotus Dome at the Rijksmuseum*[17]

For my first example, I've chosen Lotus Dome, an interactive installation created by Dutch designer Daan Roosegaarde and his studio. This piece was first shown in 2012 inside Sainte Marie Madeleine Church in Lille, France[18]. The dome itself is made up of

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[16] Biohybrid Futures, 2023. *Biohybrid Futures: Synthetic biology meets robotics*. [online] University of the West of England (UWE). Available at: https://www.biohybridfutures.com . [Accessed: 9th February 2025]

[17] Art Stories (2019) *Studio Roosegaarde's Lotus Dome at the Rijksmuseum*. Medium [online]. Available at: https://medium.com/art-stories/studio-roosegaardes-lotus-dome-at-the-rijksmuseum-15d337fa3652 (Accessed: 11 May 2025)

[18] Studio Roosegaarde (n.d.) *Lotus Dome*. [Online] Available at: https://www.studioroosegaarde.net/project/lotus (Accessed: 11 May 2025)

hundreds of small metal “lotus” flowers that respond to the presence of people. The system reacts by opening and closing petals in a chain-like pattern, so as someone walks past, the dome seems to “breathe” and move with them[19].

What I found really interesting is how this project can be seen as a type of decentralized network. There’s no single “brain” or obvious control unit, instead, the petals respond in a collective way, passing on signals like a ripple. Each unit is relatively simple on its own, but when linked together, they behave like a living system. That kind of distributed responsiveness is something I’m thinking about in our project, how messages or signals can travel through a network of elements (like my mechanical flowers) without needing a central controller.

EMANITA by WildSpark[20]

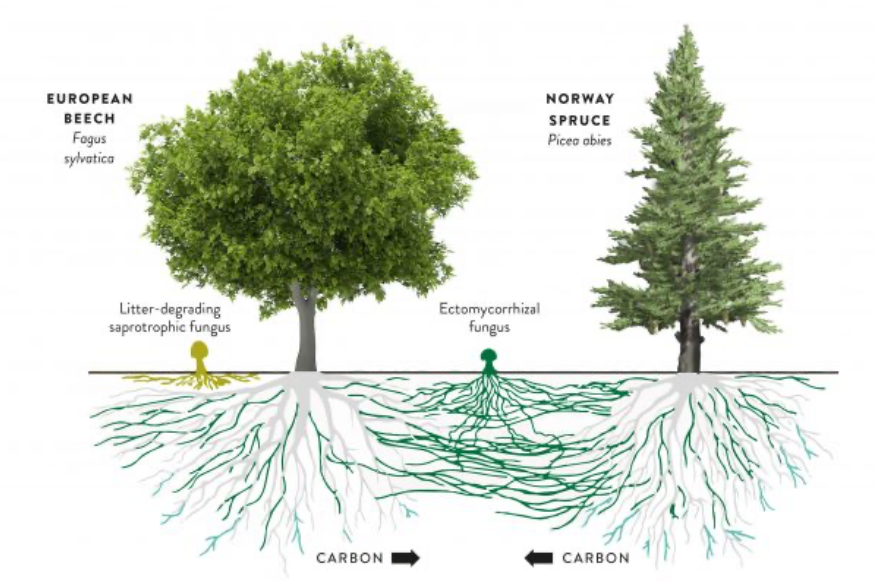
For my next example, I’ve chosen *EMANITA*, an immersive interactive artwork created by UK-based collective WildSpark. Although the piece is still in development and hasn’t yet been fully built, the concept behind it offers a compelling exploration of networked thinking inspired by fungal systems. The final design includes 16-foot-tall sculptural mushroom, surrounded by an illuminated web of glowing strands designed to represent

[19] Art Stories (2019) *Studio Roosegaarde’s Lotus Dome at the Rijksmuseum*. Medium [online]. Available at: https://medium.com/art-stories/studio-roosegaardes-lotus-dome-at-the-rijksmuseum-15d337fa3652 (Accessed: 11 May 2025)

[20] WILDSPARK. (n.d.). *EMANITA*. Available at: https://www.wild-spark.co.uk/emanita (Accessed: 11 May 2025)

a living fungal network[21]. As visitors engage with different parts of the piece for example pressing buttons or solving small electronic puzzles, the network lights up and responds in flowing patterns, simulating how information or nutrients might be transmitted through real mycelium.

What really stood out to me was how the whole piece is built around the idea of a distributed network. Like mycelium or root systems in nature, *EMANITA* functions without a central brain, instead, each part reacts locally but contributes to a coordinated whole. This aligns closely with the mechanical flower network we are developing, where each "node" (or flower) can respond individually, but also relay signals across the system. It's not just about interaction, it's about systemic connectivity and visualising how biological communication might look if we could actually see it.



The Wood Wide Web[22]

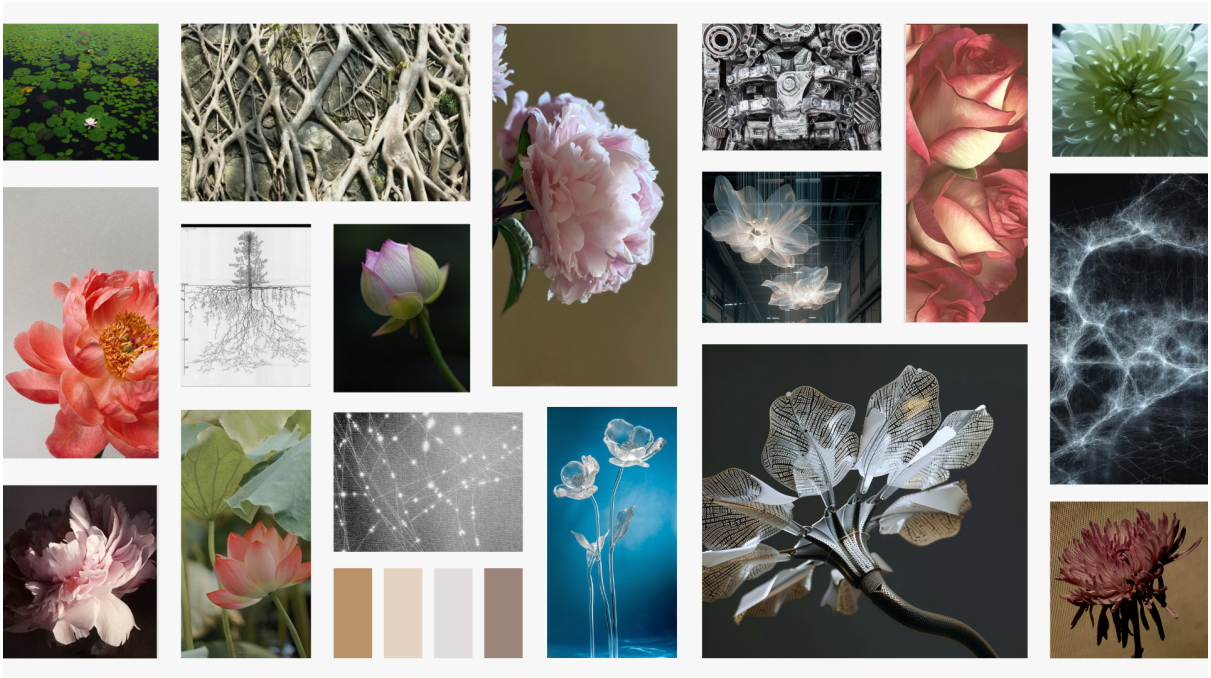
For my final example, I've chosen a research-based review titled *Wood Wide Web*[23], published in *Tecnología en Marcha* by Castro-Delgado and colleagues. Rather than being a single artwork or installation, this paper outlines the real-life underground network formed by mycorrhizal fungi, often described as the "Internet of plants". These fungal networks allow trees and plants to share resources like water, nitrogen, and

[21] WILDSPARK. (n.d.). *EMANITA*. Available at: https://www.wild-spark.co.uk/emanita (Accessed: 11 May 2025)
[22] New Zealand Geographic. (n.d.). *The Wood Wide Web*. Available at: https://www.nzgeo.com/stories/the-wood-wide-web/ (Accessed: 5 March 2025)
[23] Castro-Delgado, A., Elizondo-Mesén, S., Valladares-Cruz, Y. and Rivera-Méndez, W. (2020) 'Wood Wide Web: communication through the mycorrhizal network', *Tecnología en Marcha*, 33(4), pp. 114–125. Available at: https://www.scielo.sa.cr/pdf/tem/v33n4/0379-3982-tem-33-04-114.pdf (Accessed: 5 March 2025)

carbon, but more importantly, they transmit warning signals, support related seedlings, and even maintain inter-species cooperation depending on environmental conditions.

What makes this example especially relevant to my project is how it presents a naturally occurring decentralized communication network that is both intelligent and adaptive. The research shows how different trees act as nodes some like “mother trees” even taking on more responsibility to nourish and inform others, and signals are passed based on need, kinship, and environmental stress. This level of context-sensitive, distributed response is exactly what I want to emulate in our mechanical flower network, where each flower reacts independently but is still connected through shared light signals or messages.

Design Inspiration:



Instead of furthering this narrative of the "humans vs. machines" debate[24], we want our outcome to allow the user to look at both the natural and man-made world in an equally positive light. Exploring the combination of both aesthetics creatively and cohesively. So, for our design, we want to follow a natural colour palette for the environment, whilst the flowers will appear metallic to reflect their mechanical nature. Demonstrating the intersection of nature and technology.

Artist Inspiration:

[24] Chandran, S. (2023) Humans vs machines, Linkedin.com. Available at: https://www.linkedin.com/pulse/humans-vs-machines-swathi-chandran/ (Accessed: May 12, 2025).

WILLOW PANEL | BRUSSELS SPROUT STUDY | DOUBLE FOXGLOVE[25]

This work was created by an artist called Tommy Mitchell. Influenced by his background working in art restoration, his pieces are three-dimensional, tactile and appear realistic. He crafts these floral sculptures out of copper and brass. Sometimes, making use of gold leaf to emphasise the reflective quality of the metal. Even though he painted many of them to create the illusion that they were real plants. I preferred the cruder pieces, where it was hand-made and crafted out of metal. Additionally, by sticking to the original colour of the material, it emphasised the shape and texture of the plant. This inspired us to also create our flowers from metallic materials, aiming to reflect the robotic nature and our use of technology. Ensuring that this aesthetic continued throughout our outcome.

[25] *Tommy Mitchell* (no date) *Tommy Mitchell*. Available at: https://www.tommymitchellcompany.com (Accessed: May 11, 2025).