The Arts

Interactive architecture—UV protection unfolding above you!

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For more on **WHO COP24 special report on health and climate change** see https://apps.who.int/iris/bitstream/handle/10665/276405/9789241514972-eng.pdf?ua=1

For more on **Toronto's Shade Policy and Guidelines** see https://www.partnershipagainstcancer.ca/preventionpoliciesdirectory/ppd207/

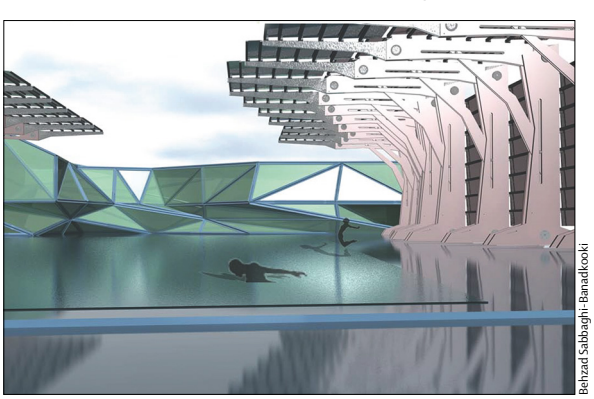
You are waiting at the bus stop. Blazing noon sun. Soaring ultraviolet (UV) radiation index. There's not a shade tree or awning nearby! You know you are going to get burned. Decision time. You are already late. Should you run back home for your hat and sunscreen and risk missing the bus? Magically, the bus stop pole unfurls a protective canopy. Sensors have detected high UV levels and your presence. You're safe in the shade! Sounds incredible? Not really. This is the future of sun-safe design.

Climate change is upon us. WHO has raised alarms about the effect climate change will have on human health. Already, UV radiation is accelerating the incidence of skin cancer. A high number of skin cancers are preventable, and shade—any means by which solar UV is blocked or reduced—is key to its prevention. In addition to tree cover, canopies, awnings, and pavilions are the most common means of providing shade within populous areas. Recent environmental design and architectural projects incorporate site-specific shade solutions for vulnerable populations, particularly children in playgrounds, school yards, and childcare facilities. Although laudable, these population-based approaches are not enough. UV exposure is a cumulative risk for skin cancer and often its most dire consequences emerge later in life. Why not consider UV protection in all public places?

Responsive architecture might be the way to go. Traditionally, the design, materials, siting, space, and systems of a building were the main architectural considerations for meeting human needs. Today, the architect's tool kit includes advanced electronic sensors enabling buildings to interact with and react to both environmental conditions and user needs. For example, responsive skins can adjust a building's mechanical system to external environmental conditions. Interactive and reactive building elements sense the presence of users and accommodate their needs. Window louvers operate according to natural light levels; room temperatures are moderated automatically as sensors respond to occupants' body heat. Walk into a room and lights come on. Put your hands under a spigot and water flows. Approach a door and it opens. Lift your bottom off a toilet seat and the bowl flushes. Interactive, responsive, and reactive design is already commonplace in 21st century architecture. So, why not apply these technologies to outdoor environments? Why not use responsive architecture in public places to create shade for UV protection?

In Toronto, a group of architects, urban designers, and landscape architects are addressing this expanding field of praxis. In 2011, at Ryerson University (Toronto, ON, Canada) I led an architectural design studio entitled *Play/Interplay—designing interactive architecture for UV protection*, in which students had to create shade in Leaside Park located in Thorncliffe Park, a high-rise apartment neighbourhood in Toronto. As it happened, Toronto's Parks Department was planning to renew the park, transforming the baseball diamond into a cricket pitch, refurbishing the swimming pool, and creating a playground for children, providing an ideal opportunity to explore how interactivity could play a role in the design of a sun-safe environment in a public place. Students were challenged to create designs that would address community needs, environmental, health and safety considerations, and provide opportunities for new design technologies. The Toronto's Shade Policy and Guidelines, directed their work. Three projects to make the park sun-safe are highlighted here.

Behzad Sabbaghi-Banadkooki's proposal, *Dancing Pool*, focused on the park's outdoor public swimming pool. Many newcomers to the neighbourhood are Muslim and public swimming for female bathers is constrained by cultural and religious proscriptions. To accommodate the diverse population of bathers, Sabbaghi-Banadkooki created an overhead canopy and pool enclosure designed to provide UV protection as well as visual privacy when needed. His proposed new insertions consist of interactive and responsive elements, expressed formally in a triangular geometry, and embracing the pool overhead and at its perimeter, in an array of arms, hands, and fingers moving to shield the pool from unwanted human eyes and equally unwanted UV rays. When deployed, side panels close, creating a visual separation between walkway and pool area. Overhead, the pool's roofing system of multiple moving arms and panels adjusts in response to UV levels and the sun's position overhead. Sabbaghi-Banadkooki's interactive design resembles the movement of a swimmer whose arms, body, and legs operate together in a perfection of form, motion, efficiency, control, and elegance.



Behzad Sabbaghi-Banadkooki

***Dancing Pool*—interactive overhead canopy and lateral enclosures**

***Coral*—dynamic roof system contracts or expands, creating an underwater sensation**

Lai Man Raymond Fan's project, *Coral*, focused on the park's central area. Fan created an indoor-outdoor space envisaged as a gathering place for neighbourhood activities. His large-scale interactive element is an assemblage of mass-produced modules, each in the shape of a fabric-wrapped triangular prism that opens and closes, as well as elongating and constricting. Modules are assembled into a triangular grid system, suspended at seven metres above the ground to create a continuous overhead covering. Within each module, triangular frames control the passage of UV and sunlight. When UV levels are high, modules close, blocking UV and diffusing sunlight. The entire system controls not only the amount of UV but also the sunlight in the space. The overall result is luminous, diffused, and directed light. As modules contract or expand, users experience a dynamic roof system, creating the sensation that they are underwater. The shelter canopy may be pre-programmed to respond to specific events. When the space is busy, modules respond dynamically and frequently, changing in height and size, creating an undulating, curvilinear form overhead. When the space is less active, all modules will return to their original resting position, creating a simple identical pattern in the plane above. This variability allows users who interact with the space to enjoy a different experience on each visit, while ensuring that UV protection occurs as needed. The overall form with its undulating elements resembles living coral organisms, giving this project its name.

In *Blooming Canopies*, Dorian Resener jumped scale and rethought the urban park altogether. He viewed the park as an extension of the neighbourhood's public spaces and created a new infrastructure sitting above the park's green spaces, bringing the pedestrian network into the park with spaces for respite, social interaction, recreation, and play. Placed above the ground plane, the walkways, bridges, overlooks, and pedestrian corridors, allow for multiple and simultaneous activities below. Shading superstructures hover above, holding modular cells where sensor-activated diaphragms open and close, responding to the ebb and flow of pedestrian circulation, programmed activities, and UV levels. Concentrated at the southern edge of the site for greatest UV mitigation, the network is designed to relate to an adjacent wooded ravine. According to Resener, "the wooden frames and tall masts replicate a forest, but in this case, with reactive foliage."

Play/Interplay asked students to consider the question of health-promotive environments—in this case, design for sun safety—within the larger issues of a changing climate. Interactivity provided them with the means to create flexible and adaptable designs that transformed space by covering, folding, and dilating, among other means, in response to human needs. Students saw interactivity as a fundamental prerequisite of effective shade design, drawing on technology to do what humans often wish to do: take cover.

Exposing students to the complexities of climate change is a pedagogical necessity. Sustainability is now embedded in architectural curricula. Likewise, the use of advanced technology provides a greater array of tools to conceive, develop, and implement design ideas. At the same time, architects are renewing their commitment to social purpose and reaffirming this as a fundamental doctrine of their discipline. Architecture, skin cancer prevention, and climate change provided insights into the interconnected challenges likely to confront them as practitioners. Although these projects proposed solutions for Toronto's four-season continental climate, lessons learned are applicable wherever demands for outdoor living and recreation collide with environmental risks of UV exposure. Creating inviting, outdoor, responsive spaces is a challenge faced by designers everywhere.

The next time UV radiation levels are high, and you're stuck, unprotected, at a bus stop, look up and imagine that in the not-too-distant-future you'll be safely in the shade.

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***Blooming Canopies*—shading superstructures hover above, responding to the flow of pedestrian circulation and UV levels**