e-Textile Carpet via an Integration of Agent-Based Simulation into 3D Studio MAX

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This research project explores the intersection between architectural design and a new computing technology, electronic textiles. By analyzing current work in architecture and computer engineering, we identify a design paradigm that can be used to improve both fields.

Both the academic and the corporate sectors have explored the utility of sense-enabled flooring with promising, although somewhat prosaic results: medical diagnostics, assisted domesticity, surveillance, and interactive games. As ZDNet puts it, "Smart carpet[s] can spot fire, steer feet, and sell beer." Elsewhere, the electronic textile (e-textile) community has realized the advantages of embedding sensor arrays into cloth: deployability, physical flexibility, and environmental acceptability. Combining the two yields the rather obvious conclusion of an e-textile carpet. Several companies, like Infineon and SoftSwitch, are currently refining the robustness, sensitivity, and fault-tolerance of pressure-sensitive fabrics. Applications in buildings include carpets, drapes, and upholstery. However, what remains to be initiated is (1) a system architecture that relates the attributes of sensor floors to the nature of inhabitation and (2) a design environment in which to develop these applications. My project explores these areas.

As seen through much of current architectural discourse, exploiting a medium's qualities is known for producing good design. The projects of August Perret and Louis Kahn are excellent examples; their projects utilize both the plasticity and the massiveness of concrete to produce forms previously unseen in other construction materials. Likewise for projects that sprung from the Bauhaus curriculum: when designers underwent rigorous training in their medium, the quality of output dramatically improved. The question of linking pervasive computing and interior design covers similar territory. By considering what it means to have a building with a carpet with a network of sensors, we can advance the building's uses.

Consider the peculiarity of contemporary location. An inhabitant's typical day is a set of discontinuous junctions connected by isolated, sterile transit. The uniqueness of passageway, of passage between, is flattened, therefore negating the physical connectedness of locations. Since there are virtually no events *between* locations, this places an overwhelming prominence upon the events that occur *in* a location. The sensor array aspect of smart carpets has the ability to mitigate this deprivation. If each sensor were given its own perspective, it would have the ability to compute based on both physical location and inhabitation. This would literally give a building's parts an awareness of their use. Physical, temporal inhabitation again becomes important. Buildings that *are* inhabitation, rather than just *contain* inhabitation can renew a sense of place.

Our resulting paradigm links the software tools necessary to simulate agent-based sensor arrays in a software environment that is conducive to spatial design. In particular, it creates a bridge between Swarm, a set of libraries typically used to model complex organic systems, and 3D Studio MAX, a 3D graphics tool common in architectural design. We chose these tools for their value in their respective disciplines. In particular, they both offer solid connections to real-world behavior. For example, Swarm is often the default agent-based simulation tool because of the consistency of its results. This feature is particularly valuable to our project, as we desire to transfer the sensed inhabitation, not the artifacts of the sensing mechanism. Similarly, 3D Studio's tools are built specifically for 3D construction, and it links into rendering engines that produce highly realistic representations of light.

We will construct our interface in a three-phase schedule. The first phase will export Swarm data to XML via Java, and it will import XML data to 3D Studio via the 3DSMax scripting language. These read/write operations will remain disparate and exhibit proof-of-concept. The second phase moves the project closer to dynamic compatibility between Swarm and 3D Studio. In order to make the Swarm output portable, we will create a stand-alone program that imports XML data and calls a COM interface exposed from 3DSMax. The third phase will dynamically link Swarm output to 3D Studio input, and we expect to port this "conversation" via sockets.

Our finished tool chain implies utility that varies from the novel to the pragmatic. The self-aware environments alluded to earlier could include a carpet that might, for example: echo recent inhabitation through LED display or use virtual "paint spills" that slowly track through a building to emphasize the relationship of the "spill site" to other locations. Other, more utilitarian aims might link user devices to building infrastructure (interior GPS, instructional narrative) or correlate behavior to location (contextual arrhythmia, navigational disorientation). Through this project, the e-textile carpet becomes a medium for design, and, most importantly, its sensors will have the capacity for location-specific memory.