Intelligent Building Skin Design

Overview
Intelligent building skins are elements of a building’s exterior façade that can dynamically alter themselves in response to variable environmental stimuli. Their potential use is especially important in reducing the energy usage and carbon footprint of existing buildings, as well as improving a building’s usability and aesthetic appeal. When considering the advantages of an autonomous and responsive façade, it is easy to understand why this rising industry is considered relevant to green building design. However, a dynamic mechanical system is more costly than a traditional static glass or brick façade. Consequently, the design must exhibit economic advantages in order for a market to exist.

Objectives
Our objective was to design a new intelligent building skin that mechanically adapts to dynamic external environmental conditions. Additionally, we were tasked to evaluate Autodesk’s software suite and its effectiveness in our design process.

Approach
- Gathered customer needs by communicating with Autodesk sponsors
- Researched information and patents on existing intelligent building skins
- Brainstormed and selected a concept design based on mitigating light transmission
- Chose a building as an example for how the design can be implemented (Recreation Hall)
- Gathered Rec hall’s energy usage data and building plans from the Office of Physical Plant
- Used Autodesk Revit to build a model of Rec Hall
- Used Autodesk Inventor to build a model of the prototype
- Used Autodesk Vasari to run solar analysis on the model of Rec Hall
- Fabricated a working scale prototype
- Programmed a microcontroller to make the prototype autonomous
- Tested the prototype on the basis of light transmission
- Used the aforementioned programs as well as Autodesk Showcase, Inventor Publisher and BIM 360 Glue to present the project

Outcomes
- At minimum transmission, the design results in a 94% reduction in solar heat gain
- The discretised polarizing sheet design is able to retrofit onto older buildings in addition to newly constructed buildings
- The design allowed buildings with large glass façades to display patterns and lettering
- The versatile design allows intelligent, autonomous or manual control