Integrated Project Thesis
University of Michigan
Stamps School of Art & Design

5G Individualized Eyewear

by Zachary Moscot 4/24/13

My grandfather has always told me that people return to the old MOSCOT shop on Orchard Street because of its consistency and endearing service. Perhaps it is because we have always kept things the same, including the old peg and groove chairs that have been there since the 30's. My father always explained to me the importance of the MOSCOT experience. "It must always be one that is memorable," he says. Having been born into a multigenerational eyewear institution, I possess the innate passion to one-day join the family business. As an aspiring designer, with the opportunity to work on a yearlong project, I was motivated to reinterpret the way we wear, see through, feel, and purchase eyewear. However, I planned to keep in mind the valuable elements that already make the process of buying a pair of eyeglasses a memorable one.

Fig. 1 – Hyman Moscot in front of MOSCOT Shop at 94 Rivington Street, 1934.

I suppose it is the family shops and the loyalty of the returning customer that has always made me believe the best products stir the most valuable relationships. Having spent time working in the shop, I have seen first-hand that these relationships exist between the object and its user and a pair of glasses and a person's face. A valuable consumer-product relationship is one that is driven by both function and emotional attachment. I am inspired by the idea that an object can facilitate everyday action while also providing a sentimental purpose.

I realize it is that same process and experience that each person enjoys and comes back to the old shop for. Using the family shop as a background for frame-fitting experience, and the consumer context as a guide, my yearlong study explores a concept for a platform for mass-individualized eyewear. Individualized, in this study, will also reference the term *bespoke*, which is often used with clothing to describe a tailored fit. It is also used to describe an item that is made to order, or ordered in advance. 5G Individualized Eyewear is a project driven by my desire to improve the end-user product by emphasizing the in-store experience while also focusing on the expertise of eyeglass fitting. The project uses handcraft and digital fabrication techniques to generate frames that center on ergonomic designs by using

consumers' individual facial and head measurements. With a balance of hand and digital craft, 5G Individualized Eyewear uses Individual Parametric Measurements (IPM) to create individualized fitting frames that provoke certain human values (refer to Fig. 2). Through product differentiation the concept targets a market of consumer individualists. And as eyewear falls into the social paradigm of fashion and visual identity, the project looks at ways to reinterpret the current consumer-product relationship.

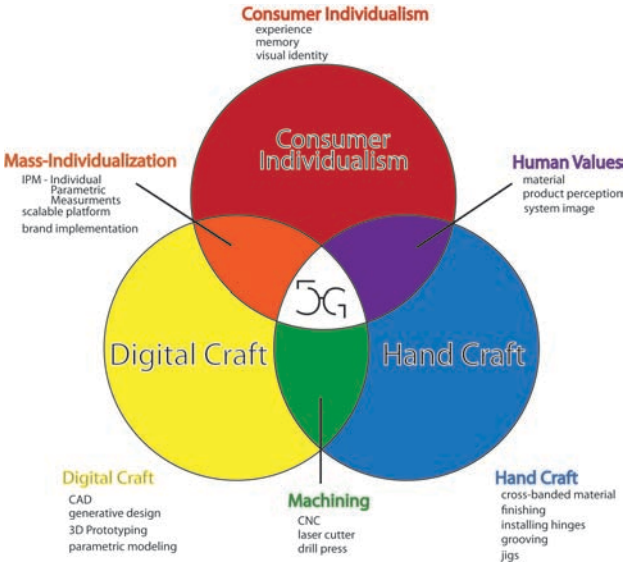

Fig 2. – 5G Venn Diagram. Moscot, 2013

Evolution of Eyewear

"One unrecorded but very special day in prehistory, an Eskimo, blinded by the ferocious glare of sun on snow, carved a slit in a piece of bone and strapped it over his eyes" (Lipow). I have always been intrigued by how a product that was created innately for function has become one of visual identity and fashion. In the fashion world things come and go. The reinterpretation of new designs and styles are determined by the context. In the world of eyewear, forms dating back to the 14th century have evolved based solely on function; however, today and in more recent times, we find that shapes are determined by trends. The evolution of material has played a major role in the changing fashions of eyewear as well. But just like anything else, especially in the medical world, products change based on what the people need and want. And as a product of personal and social identity, eyewear has fallen into the market landscape of consumer individualists looking for a specific shopping experience and exclusive, personal product.


Fig 3. – Eskimo Glare Device

Creating the Memory

The consumer experience begins by incorporating the concept of "flow" (Csikszentmihalyi, 2004). This is the ability to create the superior shopping memory. In this state-of-mind, one is fully engrossed by the activity and attention that is given to he or she. With Bespoke Eyewear, this attention occurs with detailed parametric measurements.

In the saturated market of eyewear, Bespoke Eyewear targets individualists and 'Make-it-for-me' Consumers. These individuals are typically more demanding and sophisticated. They desire individual

treatment and customer participation. The longing need to separate oneself from the mass majority of people seems to have become more and more important in today's cloning mass capitalist world. Exclusivity and personalization have become more pertinent in user consumption and wearability (Breward, 2010). By studying market trends, my goal is to create an even more intimate, participative and exclusive experience by bringing attention to the importance of functional fitting. Ideally, this kind of frame attention and individualized fitting will provoke new frame associations - apart from brand projection, and reevaluate wearer value. I will refer to this consumer product relationship as **one-to-one**. This relationship represents a personalized fit between frame anatomic parameters and the wearer's facial features and head size.

Eyewear as an Identity: Individualism, Market Landscape & System Image

Today's increasingly individualistic consumers place considerable value on self-expression and asserting their individual identity. Individualism is a mega-trend that represents consumers desire to seek products that make them stand out from the crowd and provide them with a sense of personal and social identity (Bone, 2012).

Over the past few centuries, eyewear has become a product of both cultural aesthetic and function. Today, eyeglasses and sunglasses are a form of visual identity (Morgan). The identities we create through the things we wear, especially on our face, represent who we are and the stylistic messages we try to convey. Depending on the individual, these needs are variable and also strongly context reliant. An image conveyed by the product and material is the "system image" (Norman 55). Using the current context as a guide, 5G Individualized Eyewear targets the non-conformist, independent thinker that is not necessarily concerned with brand projection or status.

In a society of consumer individualism, we find that consumers increasingly seek products tailored to their specific desires (Huang). Through primary shop observation, experience, and interaction, I have learned to understand the importance of consumer loyalty in terms of market segmentation. Seeing through the lens of a multi-generational eyewear business has allowed me to understand the importance of eyeglasses. Catering to the needs of the evolving consumer seems to have helped the shop grow and adapt to the times. Shop experience has given me the ability to see the natural progression of eyeglasses - integrated equally through medical function and fashion cycles.

I am interested as to how glasses fall into specific fashion cycles and if certain contexts or audiences can reinterpret the style by focusing on individual facial shapes, head sizes, and fitting. By using new fabrication and individual fitting techniques, the process may enable new material options. The project uses wood as a way to emphasize the process of individualization, but also to explore new

wearable perceptions with respect to the system image (Ashby). The system image is the way a product is received aesthetically and emotionally by the consumer. I'd like to see how the system image in eyewear is affected by relationships in individual consumerism, fashion, function, and material. In effect, these relationships unveil perceptional attributes that increase product value and time of wear (Ashby).

Precedents Draw the Context

It is key to analyze and look at the history of eyewear and how it has evolved both functionally and aesthetically. The context influences periods of trends and the relationships between stylistic cycles and the environment.

Cheap fashion has fundamentally changed the way we dress and has a larger cost on society, the environment, and our overall economic well-being says, Elizabeth Cline, author of *Overdressed: The High Cost of Cheap Fashion*. Since eyewear has become a fashion accessory, certain brands and companies provide cheap, short-lived products. Names like H&M (clothing) and Warby Parker (eyewear) are companies that epitomize a system where cheap products reflect the current style, but are easily discarded of. In contrast to cheap fashion and wasteful purchasing, there are handmade items meant to last for years.


Fig 4. - PP Møbler Furniture – PP501 Chair

During my semester abroad in Copenhagen, I was strongly inspired by the demand in the market for hand-made wooden furniture. I visited a factory called PP Møbler Furniture, where one chair could reach a price equal to that of an automobile. Incredibly, the person who buys this chair uses it for their entire life. The oils of the human hand and skin create a finish on the chairs arms that further enhances the beauty and timeless elements of the chair. The chair and its naturally changing aesthetics grow with the user and emotional relationships take form. Not only am I interested in the symbiotic growth that evolves between the chair and its owner, but also the sustainability of the chair via form, craft and material. "Our attachment is really not to the thing, it is to the relationship, the meanings and feelings the thing represents" (Norman 48).

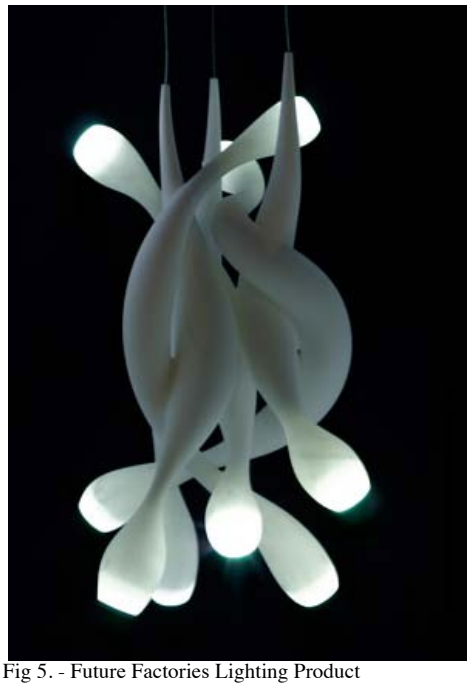
Fig 5. - Future Factories Lighting Product

This precedent pushed me to create my frames out of wood. Wood frames would not only illustrate the overall concept

due to its materiality, but they would also evoke specific association and perceptions when worn on ones face. I realized then that natural aesthetic of wood was perfect for my experiment, in that each piece would emphasize the exclusivity of the product. Moreover, the material's inability to be manipulated, bowed, or adjusted on the spot would exemplify the parametric platform, since the frame must be digitally constructed before being brought to life.

Future Factories is a studio that focuses exclusively on Direct Digital manufacturing including 3D printing and additive manufacturing or Rapid Prototyping technologies to create end-use products. Future Factories explains that Parametric CAD models update and maintain the integrity of 3D designs as elements within them are adjusted. If such changes were script-driven this would offer a potentially endless stream of one-off variants. For the sake of this exploration, a one-off variant is a unique, newly generated variation of the original form. **Generative design** has become a pertinent tool in the world of art, architecture and design. It is a revolutionary method of creating artwork, models, and animations from a set of rules or algorithms. As Marc Fornes of "The Very Many" explains, "Research and practice of computational protocols in the field of design and fabrication is "Explicit and Encoded", "Precise Indetermination", "Progressive Geometry" all seeking "Unconventional Futures"."

Generative design is the foundation for my scalable platform. However, unlike the sculptural products of Future Factoriess and the architectural art by Marc Fornes, bespoke Eyewear is precisely determined and explicit. By creating my own CAD model, the goal is to write a parametric script that regenerates the frame using the essential parameters required to properly fit a pair of glasses. These parameters are determined by the end-user to create a platform for **mass-individualization**.

5G Eyewear strives to create an end-user product that incorporates the perceptional and emotional qualities of handcrafted Danish wooden furniture by implementing innovative methods of generative design. The precedents suggest that material and technology coalesce to redefine the way the product is perceived. It is where materiality meets technological innovation in which 5G Eyewear finds a new niche in eyewear fabrication – catering to the developing needs of the individualist consumer.

Design Process & Progression

My process started with my original concept of creating one-off frames, hand-made and parametrically modeled. The original plan was to design each frame separately from one another. What this meant was that with different curves, gestures, and shapes, each frame would contrast the individual's facial aesthetics and head form. "When looking for a frame you want to wear shapes

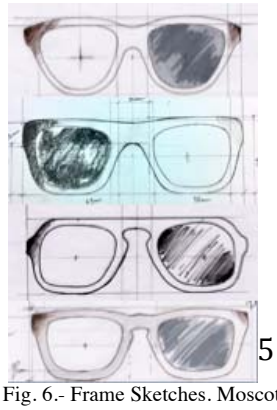

Fig. 6.- Frame Sketches. Moscot, 2012

that balance out your own. For example, if you have a long oval head, you would want to wear a square or rectangular frame," says Dr. Harvey Moscot, Optometrist and President of MOSCOT. Knowing these fitting techniques led me to study different head forms and to sketch frames accordingly. Analyzing the different curvatures of one's head, cheekbones, jaw line, and brow line, impelled me to sketch different shapes that I thought could balance different heads and faces but also bring aesthetical contrast.

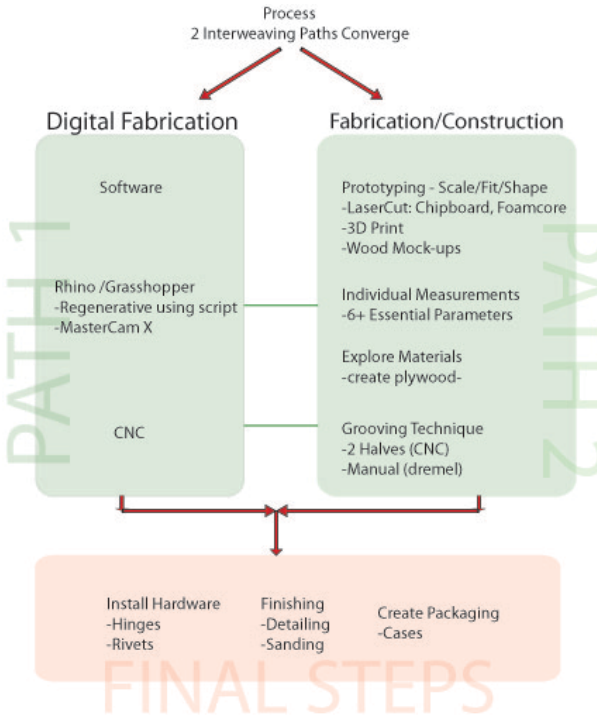

Fig. 7. – Process Diagram. Moscot 2012.

As the individualized line developed, built on pillars of sustainability, high quality, and price-worthy exclusivity, I realized that a majority of the project would exemplify craftsmanship. This came with the fear that it would not explore innovative methodologies or investigate new forms of market implementation. All through this process came the idea that individualization could be mass-produced. Instead of spending hours drawing up each frame in CAD, the new goal would be to develop a system, which would allow the designer to adjust elements of the frame and be able to generate new drawings in only an instant - the concept of a scripted platform to create **one-off variants**.

Knowing that I would now be focusing on both the digital and hand craft equally, the image of what 5G Individualized Eyewear was to become was clear. The brand would be one that equally focuses on the digital craft of each frame as much as it would the hand craft of finishing (refer to Fig. 2). This is how technology and both emotional design would integrate to create a product that is innovative, well constructed, but also meaningful (refer to Fig. 2). The logo was created as a way to visually capture the core components of the project: 5th generation family business and individually fit frames through digital parametric fabrication techniques. The logo was my way of creating a visual language for the project as a whole (refer to Fig. 8).

Fig. 8– 5G Logo. Moscot 2012

Since a lot of time was spent drawing the 3D frames, rapid prototyping became an instrumental tool. First, I would start with laser-cutting cardboard, foam core, or chipboard models as a way to bring the 2D shapes to life. This was the fastest and easiest way to see scale and curves. 3D printing was the next step and was key in determining the outcome of the frames before crafting out of wood. This was an

important way for me to bring the CAD drawings to ones face to check his or her IPM's (Individual Parametric Measurments).

With a two-path process (refer to Fig. 7), it made sense that digital work would coincide with hand construction and come to fruition at the CNC (Computer Numerical Control) machine. Since the frames were to be made of wood, I knew I would encounter issues of strength in the grain, since frame thickness could be as thin as 3-4mm in a pair of eyeglasses. One of the best solutions to creating super strong wood frames was to fabricate my own **cross-banded** grained material. In order to have wood pieces that were strong enough to route and would not easily snap, I needed to laminate the veneers and layer them so that the grain was multidirectional. Making my own material had become instrumental in the process, and separated 5G wooden frames from any others in the current market. The cross-banded veneers, laminated with the highest quality epoxy, created a uniquely strong bond.

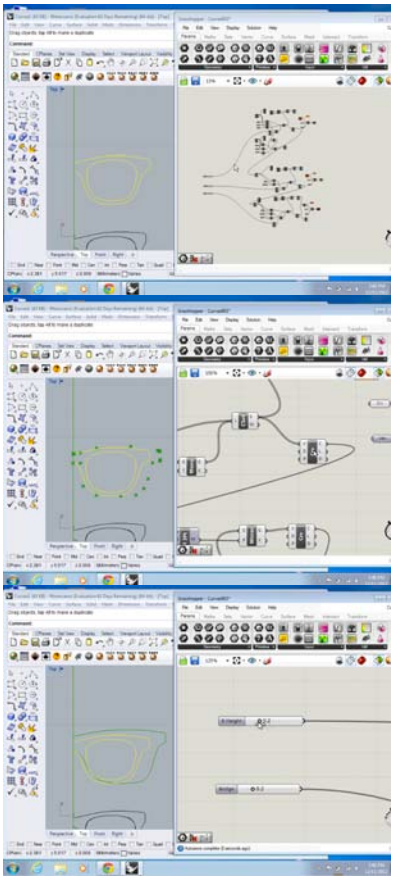

Fig 9. Grasshopper Screenshots. Moscot, 2012

In the mean time, I spent countless hours working in Grasshopper, a plug-in for Rhino, to create a parametric script that would adjust the six dimensions of the frame (refer to Fig. 9). In simplified technical terms, using visual code, I would set parameters to control the scaling of the drawings' curves. Using sliders, it was then possible to adjust the dimensions of the frame's IPMs.

Many different forms of routing were explored on the CNC. The first method: a 2-Axis cut – tool paths for the x & y were generated to cut 2D curves. In this method, the thickness of the frame was determined by the thickness of the stock and no face-form (frame curvature) was created. The second method: 2-Axis cut but the frame is split in half. This split is so that grooving could be cut with the machine and finished by installing the halves with hardware (refer to Fig. 7). The third method: 4-Axis cut – using the A-Axis for rotation, the entire frame could be routed from stock. In this method, surfaces are generated, which allows for face form. This method, like the following methods, does not implement the script and would be used only for the fabrication of frames for this project. To continue, the fourth method was creating jigs and using the laser cutter . This last attempt

Fig. 10. CNC Router Method 1 & 3. Moscot, 2012

was originally a plan-B for making the wooden frames for the sake of project completion; nonetheless, it was the ultimate way of combining all aspects of frame fabrication.

Like an onion, layers of eyewear making progressively began peeling off as the project progressed. As I previously explained, I attempted to implement all of the different elements of the frame by using different methods of making. I found that certain design problems could be solved using one method, where instead, a different problem could be solved using another. For instance, on the router, I would create stock wood by laminating and cross-banding first, then cutting. With this method I could create face form, but the machine could not route out grooves; also, for lenses, being that there was no 5th axis for cutting. I found that by reversing the process, cutting before gluing, I could incorporate both face-form and groves for lenses using a universal jig (fourth method). By contour cutting the frame on the computer, I could laser cut the frame in layers (veneers) and then align them for adhesion. Using the laser cutter, I was able to save material while cross-banding (refer to Fig. 11), but I was also able to incorporate grooving and insets for hinges. Creating and understanding the elements of a production-jig was essential. The jig was tricky in determining elements of alignment, bend, and compression. However, with the proper jig, I could generate individualized frames at a quicker rate. By reversing the fabrication process, cutting before laminating, I was able to incorporate all of the frame-form elements I had been striving to include.


Fig 11. Laser Bed. Moscot, 2013

I realized, through multiple forms and reiteration of making, that the most well crafted pair of frames came through a process of infinite trial and error. As a personal learning experience, I have acquired the most knowledge in solving problems through prototyping and making the frames. Geometry and form were the most important components of the handcraft process. I faced these aspects using the different methods of making, but only while finding ways to improve the methods along the way.

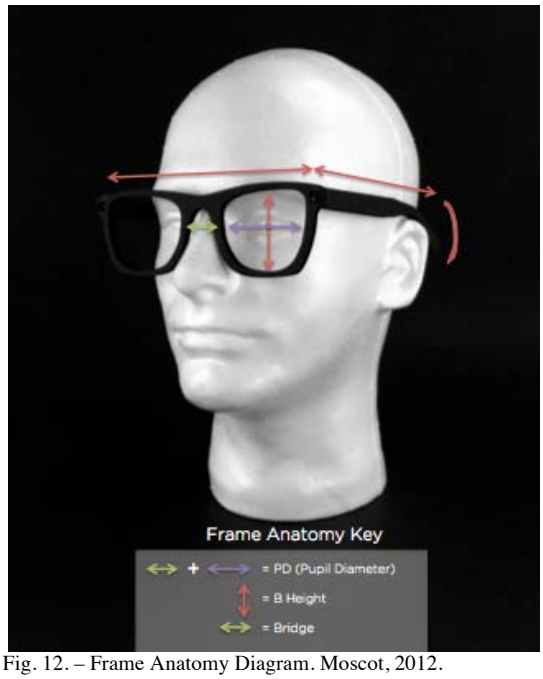

Fig. 12. – Frame Anatomy Diagram. Moscot, 2012.

Questions of Sizing, Customization & Implementation

Several questions have arisen throughout the scope of the project. A few important questions that have been posed

towards the project have been: 1 - Why is Bespoke Eyewear better than buying standard eyewear sizes, or, for example, a frame that is sold in two or three sizes? 2 – If the designer is still the one to design the frame, how much design power is the customer given? Is customization truly offered with this system?


Fig. 13 – Jessie Fass in the "Jessie Frame". Moscot, 2012

These questions are important and will help to understand the project and the difference between what now exists and what 5G Individualized Eyewear aims to do. The difference between going into a store and selecting a frame with a small pupil diameter versus a larger pupil diameter (refer to Fig. 12) is that these diameters represent the width of the frame and are usually scaled separately from other frame dimensions. For example, if a frame has a B-height of 40mm, and an A-diameter of 48mm, a bridge of 19mm, and a temple length of 140 (48/19/140), the next size up in the same model may have a 'B' of 42mm, an 'A' of 51mm and a bridge of 19mm (refer to Fig. 12 for frame anatomy). In the same way, the temple length on that model would be the same as the smaller version. Using digital techniques and parametric modeling, any parameter could be changed or remain the same or both! The difference here is that not only would a shopper who is looking at a larger size have to try to fit into it, but that when changing the size, some diameters can adjust, whereas others may not. Bespoke Eyewear implies that one person may need all parameters, or very few, to be adjusted when taking into account changing head sizes and facial dimensions (IPM). In Fig. 13, the elasticity of these dimensions show how a well fit, individualized frame will enhance the aesthetic value of the frame on the face. Jessie wears the wood frame that is parametrically fit to her face, but it is apparent that the frame does not wear her. When looking at Jessie wearing the "Jessie" frame, one can see that the frame does not ride above the brow line, nor does it sit too low onto her cheekbone. The eye is centered within the lens and the bridge is snug to the nose. The frame front does not extend beyond the width of her face. In the same way, the frame front angles downward (pantascopic tilt) from the brow to the cheek bone on Daniel's face (refer to Fig. 14). The temples on the "DG Frame" are bent snugly around Daniel's ears, providing a tight fit so that the frame does not slip forwards or off his head. The individualized fitting system shows to be a success both through ergonomic wearability and aesthetic.


Fig. 14– The "DG Frame". Side View. Moscot. 2013

With this knowledge, it is clear that the project emphasizes frame fit. With the proper fit, the eye can be centered in the lens, allowing for proper lens positioning and clearer vision. There is also a lot that can be further examined using individual fitting regarding progressive lenses and eye positioning - explaining how frame fit can affect the efficiency of all types of lenses. The goal is that the ultimate fit and parametric dimensions will maintain the integrity of the original design, but adjust where necessary in order to adapt to the individual's face. Depending on the type of frame shape and degree of adjustment, many new forms may evolve, providing the wearer with a unique one-off design (refer to Fig. 15).


Fig. 15. 3D Print Prototypes. Moscot, 2012.

Since the platform does not entail the customer's input on shapes, the concept has much room to grow. There are many ways to commercially implement the platform. An example would be if the process started with the consumer picking the frame shape that already contrasts or has aesthetic appeal on his or her face. Having already picked out the proper form, measurements would then follow. The shopping process comes to a close when the digital model of that frame is parametrically adjusted to fit the head and face of that person. The right shape and precise measurements create an exclusive product built just for that person.

Conclusion

As eyewear becomes more and a more a product of visual identity and fashion expression, it is only with time that it naturally becomes one of customization and personalization. With increasing demand for consumer individuality and tailored fitting, 5G Individualized Eyewear explored the concept of mass-individualized eyewear using a scalable platform built by digital fabrication techniques. By focusing on consumer-product relationships and the shopping experience, the project aimed to reinterpret the relationships between an individual and his or her pair of glasses, as a form of expression, but also as an emotional object with sustainable and ergonomic attributes.

In theory, this project examined both a conceptual and marketable approach to mass-individualized eyewear. With a more abstracted approach, the project looked at how a frame could be individually fit to the consumer while naturally changing the original shape of the frame. In this way, the shape is an adaptation of the wearer's face. Whereas, on the other hand, a marketable approach keeps


Fig. 16 – Daniel Gold in the "DG Frame". Moscot, 2013

in mind the integrity of a brand. For example, the frame would parametrically be adjusted to fit the individual, while certain proportions of the frame anatomy must remain in order to maintain the integrity of the original design. In this way, a specific frame or product line would not lose its distinguishable traits, market value, or brand awareness. Ultimately, through a brand-implemented perspective, the platform is utilized, which provides a bespoken frame fit and individualized consumerism.

In its entirety, the concept was successful. Through the process, I faced limitations with my ability to digitally script and fabricate all elements of the frames. As a complicated and digitally detail-driven concept, it needed more time and expertise to formalize further digital scripting and overall process management. Also, not having access to formal industry machinery made overall fabrication, but especially lens cutting, difficult. However, through an evolving process of fabrication methods, I believe I created well-crafted, wearable, wooden frames. My models for the project expressed the kind of excitement and emotional ties to their individualized frames as I had hoped for. I certainly look forward to seeking additional resources, expanding, or even implementing the concept in the future.

Product Shots & Documentation

Fig. 17– The "Jessie Frame" – ¾ View. Moscot, 2012

Fig. 18 – The DG Frame – Side View. Moscot, 2013

Fig. 19 – The Garrett Frame – Front View. Moscot, 2013

Fig. 20 – The Exhibition Display. Work Gallery, Ann Arbor, 2013.

Fig. 21 – The Exhibition Display. Work Gallery, Ann Arbor, 2013.

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