White Paper: Mass Personalized Design

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January 2023

Prior to the industrial revolution, the handcrafting process meant that a large proportion of goods were personalized: intended for particular buyers. Clothes would be made to fit, since with handcrafting there was little difference in time to create a generic or a tailored size. With machines by contrast, standardized sizes and parts bring large efficiency in manufacturing cost. This ushered in the age of mass-production. In this note we explore the idea that roboticized manufacture can bring about an era of personalized mass-production: a la carte designs tuned to individuals in which the additional cost compared to generic products lies almost entirely in the artistic effort, rather than in manufacturing. This can have broad societal consequences, creating many new jobs that marry aspects of the arts, design, and engineering, and in turn demanding changes to curricula at universities.

The key to reducing the cost of design is the development of computer aided design (CAD) tools that abstract the problem at multiple layers of abstraction and link directly to the manufacturing process. This permits the designer to re-use designs and design components, modifying only what needs to be changed to achieve the desired effect. In integrated chip design for example, one can re-use entire functional blocks, embedding even prior complete chips such as a processor and associated memory as a standard component. At the same time, the tools enable design down to the lowest level of granularity as required to optimize performance of some new component. Other tools allow even translation from certain programming languages directly to hardware layouts. The abstraction layers enable reduced designer time at the expense of some decrease in efficiency.

Similarly, CAD tools for 3-D printing enable the recombination of prior designs in addition to creating entirely new designs from low-level primitives. While there has been much publicity recently about AI-designed art, the greater value will be in tools that allow people to easily modify 2-D or 3-D structures in simulation so that realization of their artistic vision requires fewer manual steps. There is precedent in the arts: painters from the renaissance and baroque eras often had workshops, in which assistants would finish works that had been sketched out and started by the masters. Here the CAD tool would take the role of the assistant, vastly lowering cost compared to requiring human helpers. The same tools could quickly enable visualization of alternative realizations at sketch levels and various levels of finish. Of course, in many instances the digital representation is itself the finished product (e.g., video games); already there are many tools for assisting in such artistic production.

The consequences for tighter connection between artistic design and production of physical objects are wide ranging. The Burning Man festival every year shows handcrafted combinations of electronics and clothing; imagine the popularity with

reduced cost of customization. The plain architectural styles that are partly a consequence of mass production might be changed by the ability to produce more ornate forms at similar cost. We can similarly imagine more integrated structural and electronic elements to produce entirely new visual effects and soundscapes. For example, revolution in set design is possible, in turn inspiring new forms of performing arts. Furniture and other objects of everyday use can all have more personalized design features besides choosing their color. With more sophisticated tools, design can come to the masses, and thus become a greater part of everyday life. Creation of such tools will require greater cooperation between artists and engineers, and perhaps help reverse the long and unfortunate trend towards placing these disciplines in separate silos.