

# D-Tech Me: Fabricating 3D Figurines With Personalized Faces

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**Figure 1:** Example figurines fabricated by our system. The face and skin texture are customised to each individual. A range of character types are available and the system is easily expandable to new characters.

## 1 Introduction

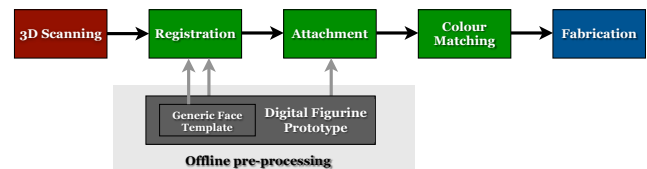
Advances in 3D printing enable custom fabrication for a fraction of the traditional cost, opening new avenues for research and commercial enterprise. This talk presents a semi-automated system for fabricating figurines with faces that are personalized to the individual likeness of the customer. The efficacy of the system has been demonstrated by two commercial deployments for Disney’s *D-Tech Me* experiences: At the Walt Disney World resort girls could choose Disney Princess characters, and at Disney’s Hollywood Studios and at Star Wars Celebration VI in Orlando customers could have their likeness “frozen” in carbonite.

Although the system is semi-automated, human intervention is limited to a few simple tasks to maintain the high throughput and consistent quality required for commercial application. In contrast to existing systems that fabricate custom heads that are assembled to pre-fabricated plastic bodies, our system seamlessly integrates 3D facial data with a predefined figurine body into a unique and continuous object that is fabricated as a single piece. The combination of state-of-the-art 3D capture, modeling, and printing that are the core of our system provide the flexibility to fabricate figurines whose complexity is only limited by the creativity of the designer. Several example figurines created by our system are shown in Figure 1.

In developing our system we considered the effects of human self-perception, and how to combine elements of the realm of fantasy with the real world. We adapted to the current color gamut limitations of 3D printing to ensure perceptually acceptable results. Our system is a flexible platform for creating customized products, and is also an experience that tangibly engages the general public with state-of-the-art computer vision and computer graphics techniques.

## 2 System Description

A diagram of the system pipeline is shown in Figure 2. Offline, a 3D modeler creates a textured digital 3D prototype of the figurine with a generic human face template. The digital figurine maybe representative of a fictional character or a design driven by artistic intent. Additionally, a subset of 19 feature points are annotated on the template face of the digital prototype. Online, the first process is to 3D scan the customer’s face with a high fidelity scanner [Beeler et al. 2010]. An artist annotates the scanned face with the same 19



**Figure 2:** System diagram. Coloured boxes are processes while gray boxes are assets. Arrows represent flows of assets.

feature points annotated on the template face of the digital figurine. A trained operator does the task in less than a minute. The annotations are used to guide the registration algorithm by [Tena et al. 2006], which separates the generic face template from the rest of the figurine and accurately deforms it to the shape of the customer’s face scan. The registration algorithm also extracts the texture from the face scan and applies it to the texture map of the digital figurine. The deformed face template cannot be directly re-attached to the rest of the digital figurine due to its new custom shape. Thin-plate splines [Bookstein 1989] are used to warp the head of the digital figurine to the deformed face template. Warping the figurine head to customer face ensures the resulting deformation is imperceptible and the likeness of the scanned subject is preserved. With the digital figurine reassembled, a human artist may smooth and edit the texture map to either match the skin and hair color of the scanned customer or adapt it to match the figurine’s style. Keeping an artist in the loop gives the system flexibility to produce figurines with different aesthetic requirements while guaranteeing consistent quality. A trained artist completes the task in a couple of minutes. Finally the digital figurine is brought to the physical world through fabrication using a *ZPrinter*<sup>®</sup> 650 provided by *3D Systems*.

## References

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