A Computer Animated Hand

By Andrew Utterson

Frame enlargement shows a “wireframe" outline of a hand as part of the digital animation process. Courtesy University of Utah.

Several decades before the widespread use of CGI and other visual effects in Hollywood, pioneers in fields well beyond those typically associated with the moving image sought to explore the computer's technical and aesthetic potential, with the aim of establishing the so-called "universal machine" — as famously described by Alan Turing in 1936 — as a machine for the creation of graphics and animation. Among these pioneers were two graduate students at the University of Utah, Ed Catmull and Fred Parke, whose short film “A Computer Animated Hand” (1972) stands as an early landmark in the development of computer animation.

In the early 1970s, the computer was still a specialist rather than widely used technology: expensive to purchase, cumbersome in size, complex to operate, limited in capacity, and generally restricted to certain sectors of society, for example commercial research laboratories and the computer science departments of select universities.

At one such institution, the University of Utah — a hotbed of computer science and in 1969 one of the original nodes in the ARPANET network of computers that would later become the internet — Catmull and Parke studied under the guidance of Ivan Sutherland, with a particular focus on the still nascent field of computer graphics.

“A Computer Animated Hand” was thus conceived not within the context of existing artistic fields, but as part of a scientific research project. The principal aim was to develop and document a process and program for animation that would address a specific set of research questions concerning the science of rendering complex objects, including the especially difficult task of rendering curved surfaces (Catmull's 1974 PhD thesis would be titled "A Subdivision Algorithm for Computer Display of Curved Surfaces"). Creating a film offered Catmull and Parke a way of demonstrating their research, with other objects of study including the animation of an artificial heart valve and a series of faces.

Per its title, what we see in “A Computer Animated Hand” is an entirely computer-generated hand that rotates and moves, as represented by a virtual camera. This titular hand is shown at various stages of the animation process, illustrating the various technical steps involved in its creation: the initial digitization of a "wireframe" outline of the hand; an intermediary process in which a limited amount of texture was applied to fill in the detail of the hand; and the fully textured hand, depicted as if in natural space and subject to light and shadow. As the hand rotates, its fingers are seen flexing, opening and closing, clenching a fist, and, in a remarkably reflexive moment, pointing directly toward the viewer—"as if to say," Catmull would later recount, "'Yes, I'm talking to *you*.'" Finally, providing an optical perspective arguably unique to the computer, the virtual camera moves and zooms as if looking from within the hand itself.

Necessarily, the technical process employed in the creation of this animation was both complex and laborious. Prior to even working with a computer, a plaster model was cast from a mold of Catmull's own left hand. To map a set of coordinates, 350 interlocking triangles and polygons were drawn onto the model hand to form a grid, with the measurements of coordinates input into the computer to create a digital version of the physical model. This data was then processed and output as a series of vectors to construct the "wireframe" outline of a hand, which was then textured, detailed, and smoothed via a process known as "texture mapping," with the rendering and animation achieved using a program that Catmull had coded. As one further stage, in order to create a film print that could be projected beyond the computer, these images were manually photographed, frame by frame, from the screen of a cathode-ray tube (CRT) display unit.

“A Computer Animated Hand” premièred not in Hollywood, nor in a movie theater, but at a computer science conference in 1973. If this was far from the first computer animation to be produced, it did represent a significant advance in the rendering and animation of the human form. The human hand — so intricately textured and capable of a seemingly infinite array of movements — was an especially complex model to render and animate, let alone with such a degree of realism. The film was a marked departure from the type of vector-based or polygonal designs — comprised of geometric cubes, pyramids, and so on — more typical of the field of computer graphics at this time.

Catmull and Parke's film would have a surprising afterlife. In 1976, foreshadowing the coming together of the technologies, practices, and institutions of computing and filmmaking on an industrial scale, it would feature in a "cameo" role in the Hollywood science fiction thriller “Futureworld” (Richard T. Heffron), where it is seen playing on a computer screen within the fictional scenario. Yet, its more significant influence and legacy would follow in the decades ahead, with the expansion of an industry in which Catmull would play a major part. While Parke would remain in academia, Catmull has become synonymous with the world of CGI and visual effects, as witnessed, for example, in his roles at Lucasfilm in the 1970s and 1980s, as co-founder of Pixar Animation Studios in 1986, and as the current president of both Pixar and Walt Disney Animation Studios.

“A Computer Animated Hand” was at the vanguard of a technological and creative trajectory for a film industry increasingly founded on CGI and visual effects. In helping to demonstrate the potential, principles, and processes of the computer as a tool for animation, this short film of a single hand would become the starting point and inspiration for countless CGI representations of the human form and other objects, now limited less by technology than by the imagination.

The views expressed in this essay are those of the author and do not necessarily represent the views of the Library of Congress.

Andrew Utterson is Assistant Professor of Screen Studies at Ithaca College, NY and is the author of From IBM to MGM: Cinema at the Dawn of the Digital Age *(Palgrave Macmillan, 2011).*