Digital Albert Einstein, a Case Study

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ABSTRACT

We present the production process for a series of short films featuring a digital actor with the likeness of Albert Einstein. The results are an artistic interpretation of Albert Einstein reappearing in contemporary context citing some of his famous quotes. This homage to the physicist and humanist further investigates how documentary film formats can extend their horizon by meaningful inclusion of digital actors. The creation process relied on a set of specialized tools which reduced the labor effort significantly. Digital assets have been released under Creative Commons to support the ongoing effort in creating convincing digital characters.

CCS CONCEPTS

• **Applied computing** → *Arts and humanities*;

KEYWORDS

digital actor, facial animation, rigging, pipeline

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1 MOTIVATION

While actors in re-enactments resemble the original only to some degree, completely digital characters can become convincing counterparts down to the smallest wrinkle. However, the project does not aim at substituting real actors, but tries to define pipelines to conserve their unique performance, including voice and gestures to create natural looking and appealing digital actors. For this use case, Albert Einstein served as a subject of investigation. His face is well-known and found its way into pop culture, although high quality reference material is extremely rare. Our goal was to create a video blog with several short episodes where Albert Einstein comments on recent events and states some of his famous quotes. Docu-fictional content or re-enactments enjoy great popularity and achieve a new level of authenticity through the use of digital images of historical personalities. In addition, they demand a dedicated production procedure that differs significantly from working on a feature film. The budget is comparatively low and thus production time and resources are restricted. Our work investigates how far a small team (two main artists and a technical director) with limited financial resources can advance in a reasonable amount of time when creating a convincing digital face and combining it with live action material. In addition, a pipeline was developed which allowed us to produce new episodes in quick succession. We bypassed a pure capturing approach, in which the performance of the actor is directly captured and transferred to the digital figure or the facial expressions are taken from scan data, and pursued a semi-automatic process that allowed direct artistic interventions. In the case of Albert Einstein, there is a lack of references, so an artistic approach was a given requirement.

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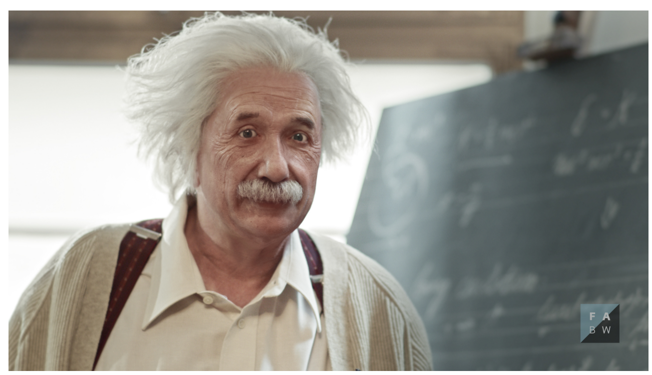
2 MODEL CREATION

A professional sculptor[1] created a PVC bust using reference photos and film footage. A colored cast of soft silicone served as additional inspiration for the reflective properties of the face. The PVC bust was digitized using photogrammetry at Disney Research in Zurich and served as a reference and basis for the following digital sculpting. After carefully retopologizing, we refined the scan based on photos, approximating the geometry to Einstein's physiognomy before devoting ourselves to the facial hair and details such as wrinkles and pores.



3 ANIMATION RIG

The foundation of the facial deformation system is based on the Facial Animation Toolset[2] that has been developed in recent years at Filmakademie Baden-Württemberg. The Adaptable Facial Setup (AFS) [Helzle et al. 2004] is an approach that uses captured facial data to automatically generate the basic building blocks of facial muscle group movements, which can be employed to animate entirely new synthetic performances. Thanks to an adaptation process, the non-linear characteristic of the facial movements can be preserved, allowing the transfer of movements to other characters with

[1] http://www.janptassek.de/
[2] http://fat.research.animationsinstitut.de

different topology, and speeding up the process in comparison to the creation of blend shapes. More details on the rigging approach including a perceptual study was presented as workshop paper [Yu et al. 2017] and is currently under review for further publication. Some signature expressions required manual sculpts due to limitations of the AFS approach. This was realized through a total of 19 corrective shapes. To enhance the realism of the character, we integrated a skull mesh and a muscle system that forced the skin to slide over the underlying geometry. Lastly, a curve-blending approach was used to simulate sticky lips. Although the setup consisting of various sub-rigs and muscle evaluation got quite complex in the end, the final rig performed close-to-real-time. The digital asset is available for evaluation on our website[3].

4 CAPTURE VS. ROTO

On the day of the live action shoot we filmed the actor with a wig, so that he resembled Albert Einstein. Once the principal photography of the plate material had been completed, the footage was matchmoved and we started an attempt to track the facial performance. However, the animator decided to completely discard the animation derived from the tracking process as the quality could not at all cope with our expectations. It was much more convenient to animate the face from scratch, keeping control over every single slider provided by the AFS, and being able to perform changes quickly when needed. Already in this very first animation pass, it became obvious that subtle adaptations to the original facial expression were desired in favor of a more appealing and therefore artistically motivated movement. Blinks were added, some facial expressions replaced and the pace slightly changed.

5 INTEGRATION

The skin material was build up of a Vray subsurface material and two standard Vray reflective materials. High resolution textures were prepared for both the individual skin layers and the reflections for which we reconsidered the scans of the silicone bust along with reference photos of Einstein. For skin details, such as pores and wrinkles, we provided a displacement setup in which individual displacements modeled for specific expressions were exported as maps and activated accordingly by animation controls. The result was a dynamic displacement map, which, depending on the animation, ensured that wrinkles formed or smoothed out in defined areas of the face. The finest patterns of the epidermis were obtained via a dynamic microstructure in the bump channel. This map was sharpened or softened according to the compression or stretching of the skin to simulate the deformation of the surface by the underlying bone and muscle movements. The filtering was not done directly in Maya but was precalculated and applied to the microstructure as a texture sequence. To what extent the microstructure affected the perception of the final image is currently a subject of further investigation. The 3D scene was shaded and lit using light probes from set. Additionally, manually placed light sources helped to harmonize live action footage and computer-generated imagery. The digital Einstein got merged with the backplate after rendering. Color correction, depth of field and motion blur contributed to the integration of the digital content and constituted the last steps in composing the final image.

[3]https://goo.gl/u8qnDV

6 CHALLENGES

For the actual animation, we initially planned to capture the actor's performance with Faceware[4] and transfer it to the digital face, a workflow that we thoroughly explored in pre-production and found to be feasible. Unfortunately we had to learn that this approach was not practical, because the images of the Arri Alexa camera, which we wanted to use for tracking, were not suitable due to low resolution and high motion blur. The actor's face did only cover a quarter of the image height in most shots. Future projects would address this issue with higher resolution and better coverage by witness cameras. Both the body and the head of the actor proved to be too voluminous for the build of Einstein and required an intervention in compositing, using warp nodes for slimming the body and adapting the head shape, cheeks and forehead. In some places the background has been extended. It was certainly risky to assume that one could detect the rigid head movement of the actor without further aids such as tracking markers or witness cameras in sufficient quality. One future solution for this challenge would be to shoot in two passes, the first with actor and wig for head tracking, the second with a high-resolution helmet camera for facial performance capture.

7 PRODUCTION STATISTICS

The total duration of the 3D asset creation (basic geometry, animation rig, shader, dynamic displacements, facial hair and look tests) was estimated with 77 days (~4 months). The creation of the 3 short film episodes (tracking, animation, shading & lighting, compositing, sound design, grading) was estimated with 76 days (~4 months), resulting in the total production time of 153 days and 8 man month respectively. As not all involved personnel was working full time on the project the overall creation time was about 6 month.

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[4]http://facewaretech.com/