IBC 2021 Accelerators: RT-3D Interactive Content Creation for Multi-Platform Distribution.

A Real-time 3D Interactive Content Creation User Study with Expert Users

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Abstract: Real-time interactive tools, when combined with 3D visual content, can be applied across a wide range of industries from media entertainment content to studio set design. With the recent reinvigoration of extended-reality (XR), the potential of this technology has exploded back onto the 3D media technology scene in a way that might potentially permanently disrupt current production workflows. With this latest development, interest has been expressed to introduce new real-time 3D pipelines into multiple areas of the media industry. In the presented study, we explore previous experiences and knowledge of 3D technology in the field, gather information about the current needs and requirements of contemporary 3D visual artists, and report on the potential future of 3D content creation from an industry perspective. It is expected that this user-type focused data will inform the design of new software and tools for this targeted user-specific cohort.

Methodology

The purpose of this study was to explore advanced-user attitudes and previous experiences regarding animation, 3D modeling, and motion capture. This process involved observing, engaging, and empathizing with creative technologists to gather data on their experiences and motivations to use new tools and build a personal understanding of their concerns, requirements, and challenges when using technology in real-world practices. This data will provide VR application creators and XR developers with an empathic understanding of the people they are designing for and their attitudes when using this technology. Thus, a heuristic experiment is presented that exposed advanced digital technology users to innovative animation, 3D modeling, and motion capture technology designed for traditional screen-based media and VR.

Participants, Apparatus, and Materials

Recruitment took place in the Republic of Ireland during the latter half of 2021. A general call for participation was made through the project and the university network. Volunteers were sought across a broad spectrum of potential user types. Participants were asked to report demographic information via an online questionnaire. This data included age, gender, education, and employment domain. The participants were asked to identify on 5-point Likert scales their competencies with digital technologies (1 = Unskilled to 5 = Excellent); their familiarity of animation, 3D modeling, and motion capture (1 = Unfamiliar to 5 = Extremely Familiar); and their expertise using animation, 3D modeling, and motion capture technologies (1 = Novice to 5 = Expert). Participants were then scaled as "Novices," "End-users," and "Advanced Users," as described by Nielsen (1994).

In total, 22 participants were invited to attend the session. Eleven of which contributed to the study (response rate = 50%), identifying as 9 Males and 2 Females with an average age of 36.73 (SD = 8.81).

According to the Irish National Framework of Qualifications (NFQ), the education profile of the cohort consisted of levels 10 (n = 5), 9 (n = 4), and 8 (n = 2). According to the professional Nomenclature of Economic Activities (NACE), the group's employment sectors were Education (n = 7) and Scientific and Technical Activities (n = 4); this included researchers, Ph.D. students, lecturers, directors, consultants, graphic designers, and tech company CEOs.

The cohort was invited to experience animation, 3D modeling, and motion capture technology during a group visit to RTÉ in Donnybrook, Dublin (Ireland's national broadcast headquarters). Each session was scheduled for 1 hour and implemented COVID-19 social distancing and hygiene protocols. Noitom's Perception Neuron motion capture (MOCAP) device was demonstrated to the group, including real-time rendering and animation on a large-screen display. Participants were encouraged to interact with the demo and ask questions. Two VR stations (Oculus Quest 2 Link) were also set up for experiencing animation and 3D modeling using VR. For this purpose, Tvori and Masterpiece Studio were used as exemplar applications. Following this, participants were debriefed and allowed to ask further questions.

Perception Neuron (www.neuronmocap.com): Perception Neuron Studio is a motion capture solution from Noitom that boasts industry-leading sensor technology and an innovative sensor-processing algorithm, giving users the potential to explore new approaches to motion capture. The system is a packaged solution with inertial trackers that provide a precise motion capture experience. This system includes inertial body sensors for full-body tracking, a transceiver, and gloves containing six 9-DOF IMU sensors.

Masterpiece Studio (www.masterpiecestudio.com): Masterpiece Studio Pro is a fully immersive 3D creation pipeline. It provides a suite of professional, intuitive, and easy-to-use immersive tools. Users can create high-fidelity 3D models and animations using easy-to-use and intuitive tools. The application allows users to create 3D concepts within VR, sculpt 3D assets, and prepare meshes for many different professional workflows.

Tvori (www.tvori.co/tvori): Tvori is an animation and prototyping software for VR and AR that can be used for previsualizations, animatics, or VR films. The application makes designing for both AR and VR simple. This software package can be used collaboratively to prototype interfaces, products, and experiences for XR. It is easy to learn, provides animations for design transitions and user interactions, and can be used collaboratively by teams and clients remotely.

After the studio visit, participants were invited to complete an online questionnaire to capture their impressions of these technologies in real-world practical situations. Qualitative data was captured to explore previous knowledge and experiences, potential benefits and problems of the technology, and future industry-focussed needs. The following questions operationalized these topics: "What previous knowledge or experiences have you had with the animation, 3D modeling, and motion capture technologies you have experienced today?"; "What benefits or problems do you see arising from using animation, 3D modeling, and motion capture technology in this way?"; and "What do you think you would need from future animation, 3D modeling, and motion capture technology like this?".

Results

Empirical data was collected and analyzed. Quantitative data was used descriptively to report on the cohort demographic. Qualitative data were coded and used to enrich and add depth of knowledge to

our aims and objectives. The analyses of open-ended questions took a thematic approach guided by the frequency and fundamentality of the issues raised by the participants (Adams et al., 2008; Nowel et al., 2017).

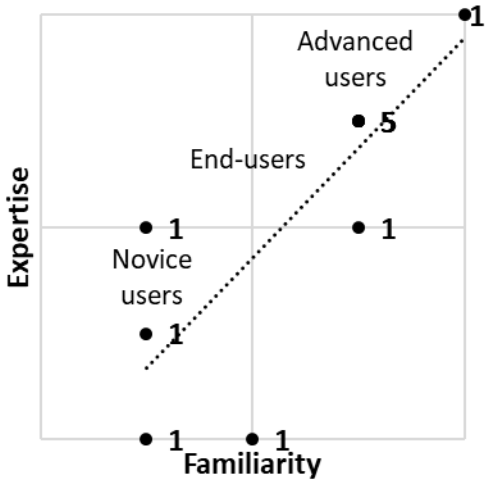

Figure 1: User-cube representing user types (the dotted line represents the linear average).

Population Variables

Data relating to the cohorts' ability to use digital technology (M = 4.73; SD = 0.47), their familiarity or knowledge of animation, 3D modeling, and motion capture (M = 3.45; SD = 1.04), and their expertise or experience in using animation, 3D modeling, and motion capture technologies (M = 3.18; SD = 1.33) were captured to identify specific user-types (Nielsen, 1994). All participants were self-reported as having an "Excellent" ability to use digital technology. The distribution of user types was weighted towards End-users (n = 2) and Advanced users (n = 6) of animation, 3D modeling, and motion capture technologies (see Figure 1).

Previous Knowledge and Experience

The cohort reported previous industry, lab-based, and educational experiences of 3D modeling and animation using Maya, Cinema 4D, 3D Studio Max, and Unity 3D, and familiarity with more bespoke content creation approaches, such as volumetric capture and reconstruction techniques. Most cohort members had previously experienced different versions of the presented technologies and platforms at exhibitions and conferences or had applied them in some way in their place of work. They also conveyed some real-world experiences with motion capture, although it was the first time some had seen a real-time motion capture and rendering pipeline firsthand. Traditional platforms for content creation were described, PCs, laptops, etc., and some group members were intimately familiar with VR development. The cohort was knowledgeable of the gaming and movie industry and was familiar with the technology, terminology, and the leading companies involved in the field. The more advanced users within the group were skilled in 3D reconstruction algorithms, markerless motion capture, content creation experience in VR, and knew of the Perception Neuron Kickstarter.

Table 1: Visual presentation of themes

What are experts' opinions on using contemporary animation, 3D modeling, and motion capture technology in practice?			
	Previous Knowledge & Experience	Advantages & Disadvantages	Future Requirements
Themes	• Industry, lab-based, and educational knowledge • Commercial software as well as custom-built software experiences • Familiar with the presented technologies • Had applied similar techniques in practice	• Natural movement • 3D from conception • Real-time visualization • Low entry usability • Comfortable to use • Faster data collection • Lack of training • Equipment hygiene • Accuracy of the data	• Financial investment • Upskilling • Follow industry trends • Learnability • Usability • Provide robust data • Classroom to stage education pipeline • More use-cases
Examples	*"I am experienced in using Maya, Cinema 4D, Unity for 3D modeling and animation."* *"We build 3D reconstruction algorithms and do markerless motion capture."* *"I worked as a 3D animator."* *"I have knowledge of this technology from the gaming and movie industry."*	*"One of the major benefits is the use of natural movement for animation and also the ease of use."* *"It can be good to think and create in 3D."* *"You need someone familiar with the tech on hand."* *"Lack of external camera tracking/noise of the sensors."*	*"Creative ideas on how to use it."* *"A good training course would be useful."* *"3D modeling software which allows not only artists but other enthusiasts."* *"Virtual production will need further development."*

Advantages and Disadvantages

One of the significant benefits identified by the group was the use of natural movement for animation and the technology's overall ease of use, for example, "As part of a complete pipeline, it could allow for quicker pre-visual and broadcast-quality animation." Each platform experienced and discussed was also advantageous for three-dimensional thinking and creating throughout a project's lifecycle. This approach to a 3D rational was expected to benefit the creation of new content that could be produced quicker and with more realistic representations of human movement. After experiencing 3D modeling in VR, some participants thought that creating 3D models in a fully immersive 3D environment was more intuitive and ergonomic for the artist than building via traditional 2D screen-based desktop media. As one participant described:

> "It feels more natural, like drawing or physically sculpting with physical materials (e.g., stone or wood), than drawing with a mouse. I also like that it encouraged me to stand up while working, which I feel is healthier than constantly sitting at a desk."

The low entry usability and comfort-of-use were considered an advantage for novice users, making the industry more accessible for more "casual" creatives, for example, more agile and mobile motion capture approaches instead of much stricter fixed MOCAP suites. The Perception Neuron Studio captured data from multiple sensors, ensuring precise motion tracking in line with other studio-based operations. The instantaneous capture and display capabilities of the technology pipeline also enhanced this feature — "Which means you can solve many problems in real-time."

The featured technology was also considered beneficial from a research perspective as it facilitates faster and more accessible data collection, allowing users to create more extensive and diverse datasets, which are essential to current machine learning technologies. Another benefit was identified as the production speed, where creating television shows with a real-time virtual host could be realized quickly. As one participant reported:

> "The integration of the 3D model with Unreal or Unity and the motion capture suit appears very easy and will lead to a more rapid workflow. The motion capture suit is more portable than traditional approaches that use many cameras to track the actor."

Disadvantages were also acknowledged. Notably, the requirement is to have someone trained and familiar with the technology to guide and troubleshoot potential issues at every production stage. Another drawback was the requirement for high-end computer systems to process data efficiently. Some participants also believed that VR modeling would not be a suitable replacement for working in a traditional 2D environment and would instead be more useful as a viewing tool or for making minor adjustments to preexisting content. As a product of the COVID-19 pandemic, it was also highlighted that virus transmission could occur when using communal VR equipment and the constant need to sanitize equipment before and after use.

It was also reported that VR and MOCAP technology may still be too expensive. The initial costs to train, set up, and operate and the technical and hardware requirements would continue to make it difficult for general day-to-day use. Specific to the complete 3D modeling, MOCAP, and reconstruction pipeline, participants thought problems might arise concerning the accuracy of tracking live actors within a studio with multiple wireless technologies running simultaneously. In this case, signal quality may suffer due to the lack of external camera tracking and possibly the inherent noise of the different wireless sensors being used. However, it was acknowledged that this potential problem might be addressed through training and familiarity with the system in question.

The Future of Technology

Fundamentally, all participant group members commented on financial costs, a general lack of technology-specific expertise, and the requirement of effective teaching materials for continued growth and acceptance within the industry — "A good set of tutorials as well as someone with expertise that can troubleshoot." Moreover, although the cohort reported that the technology they experienced looked promising, the rise of virtual production tools will need further development concerning the availability of future skilled operators. On the one hand, a financial investment would be required to replace established traditional studios with next-generation real-time sensors and immersive virtual environments. On the other hand, it would also require industry-specific training to operate such systems. Therefore, a streamlined course should be created for advanced users to become fully accustomed to 3D control panels and the various available tools.

The group recognized that future growth in this area would require increased access to 3D modeling and motion capture pipelines to be integrated into the classroom to train the next incoming peer group of studio operators. Thus, the technology would need to be learnable, easily calibrated, and provide a robust data capture process reflective of the era's industrial applications. The pipeline would also require data to be captured in an open and streamable format to create and drive virtual 3D characters across multiple platforms. However, it was expressed that this technology's usability, affordability, and accessibility should not be detrimental to its accuracy. By achieving these goals, artists and other enthusiasts would have powerful 3D modeling, animation, and MOCAP capabilities. Future animation, 3D modeling, and motion capture technology (including mobile and wearable devices) will also facilitate and drive creativity and develop new ideas on using them effectively in practice.

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