

468886

How to Not Get Away with Murder: Modeling Judicial Evidence

Joshua Chartrand
Carleton Immersive Media Studio

Learning Objectives

- Discover the need for 3D technology in the judicial system
- Learn how to replicate a series of events based on written and photographic information
- Learn how to render an accurate texture onto a 3D model based on reference photography
- Learn how to compile a medical-style model with materials and annotations in Unreal Engine

Description

Carleton Immersive Media Studio (CIMS) has been involved in the 3D modeling of judicial evidence for homicide cases since 2015. The lab has refined its modeling workflows based on the established use of reality capture (photogrammetry) and BIM (Building Information Modeling) to model artifacts and buildings. Working with the coroner’s office, CIMS has incorporated newer forms of 3D modeling and real-time rendering to establish a standard for displaying digital representations of photographic evidence in a courtroom setting. In this class, we’ll cover our modeling process, starting with analyzing evidence to presenting the data in a user-friendly format. Utilizing Maya software, we’ll model a series of anatomical base meshes that we’ll then manipulate to show inflicted injuries. Next, we’ll texture map the models in Mudbox using photos as reference. Finally, we’ll combine the pieces in Unreal Engine using a template. The addition of blueprints and widgets complete the final product.

Speaker

Joshua Chartrand has been a developer and team lead at Carleton Immersive Media Studio for over three years. In April 2018 he graduated from Carleton University’s Bachelor of Information Technology program in Ottawa, with a focus in Interactive Multimedia and Design. He has contributed to many of the lab’s Digitally Assisted Storytelling projects, including the Senate Virtual Tour, the Canada 150 VR Kiosk, and Parliament The Virtual Experience. His focus is in the use of game engines to produce interactive experiences and games. His current research involves redefining the meaning of a National Historic Site through the use of digital technologies.



Carleton Immersive Media Studio

The Carleton Immersive Media Studio (CIMS) is a Carleton University Research Centre (CURC) affiliated with the Azrieli School of Architecture and Urbanism in the Faculty of Engineering and Design in Ottawa, Canada. Over the past decade, CIMS has built an international reputation working with public, private, and not-for-profit partners. Our diverse portfolio demonstrates the value of new and emerging digital technologies for architectural rehabilitation, heritage conservation, and the Architecture, Engineering, Construction, and Operations (AECO) industry more generally.

Currently, research associates and assistants — post-doctoral fellows to undergraduates — are trained in a range of disciplines including: architecture, computer science, engineering, human-computer interaction, public history, and information technology. This diversity and commitment to multidisciplinary has created a unique research and training environment that is conducive to imagination, innovation, and a comprehensive research education.

CIMS is involved in four streams of inquiry: **Digitization**, **Modelling**, **Digitally Assisted Fabrication**, and **Digitally Assisted Storytelling**. These diverse research interests have cultivated a multi-disciplinary team.

Digitization

Our digitization research focuses on the accurate recording of the material world into X,Y,Z coordinates and/or RGB values using terrestrial laser scanning, photogrammetry, and 360 photography and video. Over the past decade, CIMS has recorded more than ten terabytes of georeferenced point cloud using terrestrial laser scanning and photogrammetry. We capture both interior and exterior environments at level of detail that are appropriate for the unique demands of each project. Our projects range in scale from one-room prairie churches to national (Parliament Hill) and world (Rideau Canal) heritage sites. Our expertise in the digitization of existing conditions has been leveraged for infrastructure management, architectural rehabilitation, and heritage conservation including the generation of building information models, high fidelity meshes of heritage assets for digitally assisted fabrication, and public outreach material.





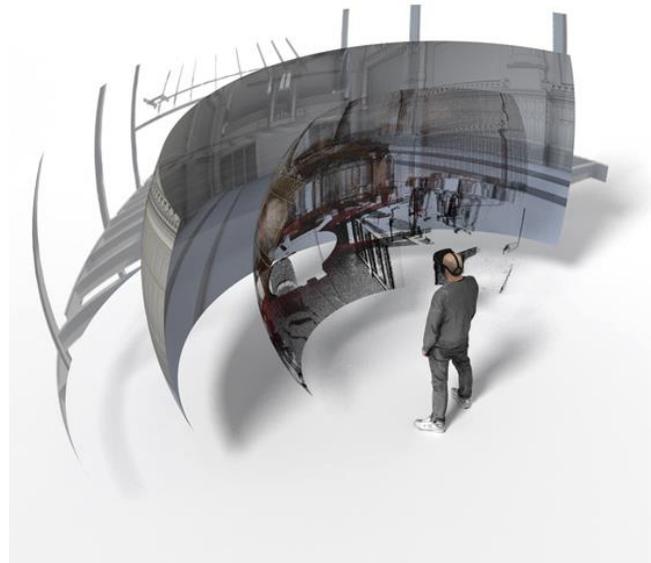
Modelling

Our team is experienced in modelling existing conditions and integrating digital assets from diverse datasets at multiple scales—objects, buildings, intra-urban districts, cities, and inter-urban regions. We have a multi-scale and typologically diverse record of modelling from the human body for forensic evidence modelling, to one-room prairie churches and campus Building Information Models, and large-scale urban models of Eastern Ontario covering over 44,000 square kilometers. Most notably, CIMS has played a key role in the research and innovation of Building Information Modelling (BIM) for existing conditions and heritage buildings. Using various documentation methods, CIMS has developed an approach to digitization and 3D

modelling of heritage structures, pioneering their integration with the architectural field of BIM. All of our best practices for BIM are documented in an extensive library of protocols that we share directly with industry, academic, and governmental partners and through knowledge mobilization events – conferences, seminars, blog posts, and workshops.

Digitally Assisted Storytelling

Our digitally assisted storytelling (DAS) research leverages processes and assets from the digitization, BIM, digitally assisted fabrication, and simulation research to create engaging narratives for public dissemination through online, mobile, and on-site exhibitions. CIMS’ DAS research began in 2010 when CIMS partnered with the MacOrdum Library at Carleton University, the Bytown Museum, and the Canadian Heritage Information Network to develop a virtual exhibit called “Heritage Passages”. The exhibit addressed the relationship between the building of the Rideau Canal and the transformation of Ottawa from a Lumber town to a city. Since then our DAS research has grown significantly, developing several online tours, websites, and virtual and augmented reality experiences. We credit the expansion of the DAS research to the truly multi-disciplinary nature of the lab. This synergy has led to virtual tours and VR experiences that contain engaging narratives, well-designed content, and functional interfaces.





Digitally Assisted Fabrication

Since 2013, the course of CIMS computer-aided manufacturing research has greatly evolved and it is now one of our five main areas of inquiry – digitally assisted fabrication (DAF). Our DAF research aims to develop a process that augments traditional craft workflows with digital technologies. Early projects included the digitization and fabrication of architectural assets on Parliament Hill - column capital (3D printing), tympanum (3-axis CNC), and owl sandstone relief (off-site robotic mill). In 2016, we purchased two, seven axis robots – the Kuka KR360 and the KR6. These robots have been used to work with traditional craftspeople, including the Dominion Sculpture Phil White, on several projects including developing a scaled mould to cast the Canada Coat of Arms,

digital fabrication files of decorative elements for the Senate of Canada (maple leaves), and fabricated elements for the Senate of Canada (provincial crests and flags). As one of the only robotic systems of its kind at an academic institution in Canada, it has gained a lot of attention leading to multiple speaking and media events. All of our best practices for CAM are documented in an extensive library of protocols that we share directly with industry, academic, and governmental partners and through knowledge mobilization events – conferences, seminars, blog posts, and workshops .

Evidence Modeling

Back in 2015, CIMS was approached in helping the Ottawa Crown Attorney in developing 3D models as part of a homicide case. Since then, the lab has developed models of crime scene interiors, 2D injury maps, and injury models embedded in a 3D PDF. Early 2020 brought upon a new case with the challenge of mapping more than 50 injuries – a new way to present this data was needed.

The purpose of Evidence Modeling is to: create an accurate representation of the photographic evidence in a digital, **nonsensational** format.

The Need for Digital Evidence

In more recent years, jurors, audience members and attorneys themselves have come forth describing the PTSD they have faced from being in court. The Leblanc Murder trial that occurred in Ottawa, Canada in 2018 had a juror completely faint after witnessing the gruesome description of the victim’s wounds, halting the case midway through testimony.



“Dr. Alfredo Walker, a forensic pathologist with The Ottawa Hospital, was just beginning his full- day testimony about the autopsy he performed the morning after the killing, when court was abruptly halted for the apparent medical emergency. Walker was in the midst of explaining a single-edged blade’s effect on the muscle and sinew on Hassan’s neck, describing in clinical detail the “gaping” four-centimetre stab wound he found there. Walker was then pressed into an unexpected court duty, springing from the witness stand to the jury box as the juror rolled backward in his chair and began convulsing¹.”

Four Reasons for Digital Representation

1. Dignity for the victim and their family
2. Reducing PTSD amongst members of the court
3. Clarifying the order of events and what really occurred
4. Holding a record of the acts that took place

Analyzing the Evidence

Once getting a hold of the autopsy and coroner’s report & testimony, the lab got to work on organizing the data. They created a custom schema in excel to match the injury list to the photographs given as reference that needed to be recreated in a 3D format.

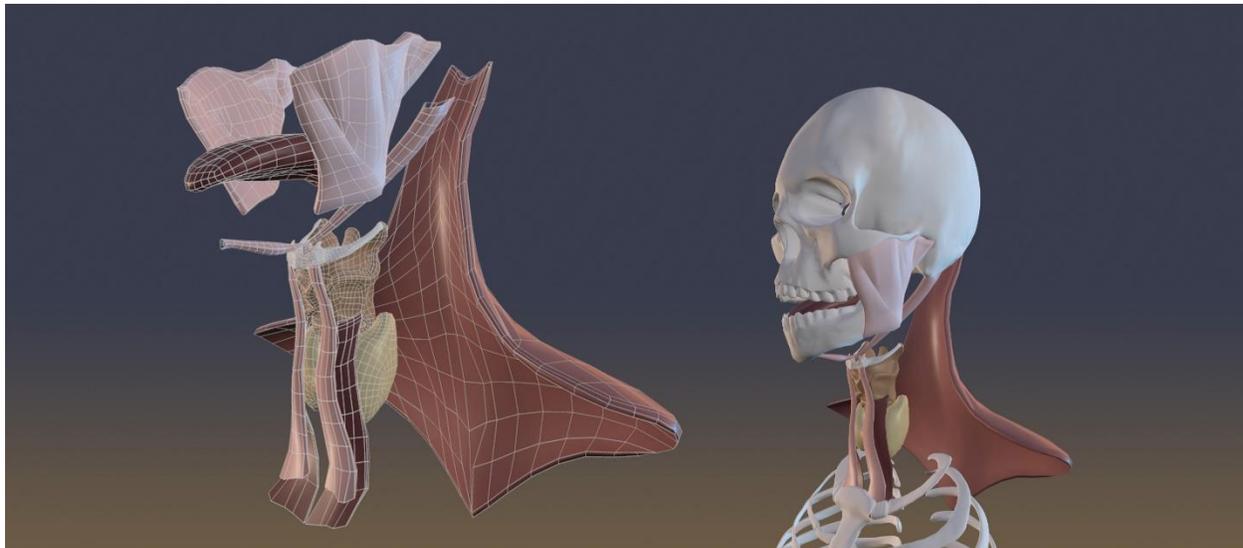
¹ Helmer, Aedan. “Juror Faints as Pathologist Describes Gruesome Wounds in LeBlanc Murder Trial.” Ottawa Citizen, 21 Sept. 2018, ottawacitizen.com/news/local-news/juror-faints-as-pathologist-describes-gruesome-wounds-in-leblanc-murder-trial.

Injury Number	Description	Size [cm]	Type	Body Part	Body Area	Additional Comments	Photos
1	A 14cm x 8cm maximal dimension region of patchy red purple bruising across the forehead	14 x 8	Bruise	Forehead	Head & Neck	Top right side of the forehead, towards the end of the ruler	2994

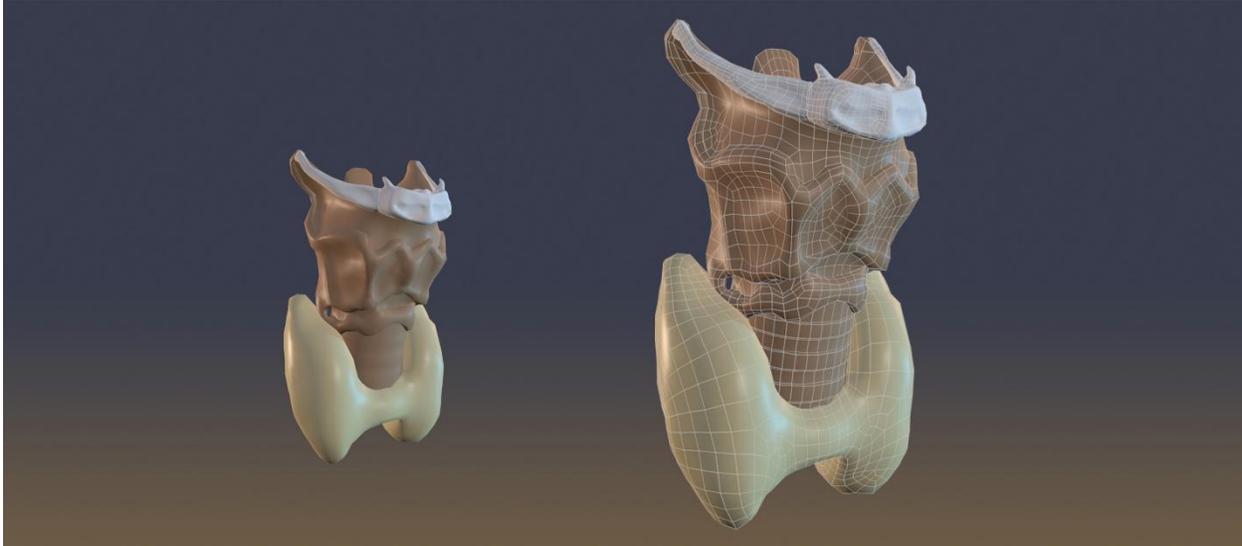
An example of the custom evidence modeling schema.

Developing the Models

The next step was to create a set of anatomical base meshes in Maya that could be further manipulated to indicate where injuries had been taken place. The creation of these meshes were for repeated use in the future if any other cases were introduced.



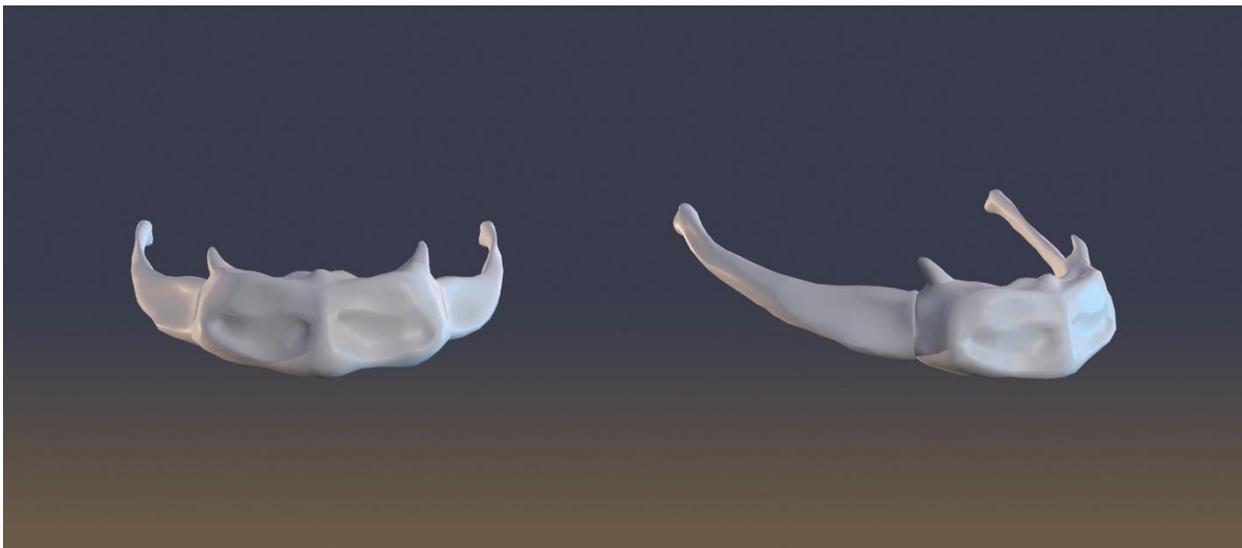
A collection of anatomical base meshes.



The Larynx bone and muscle structure.

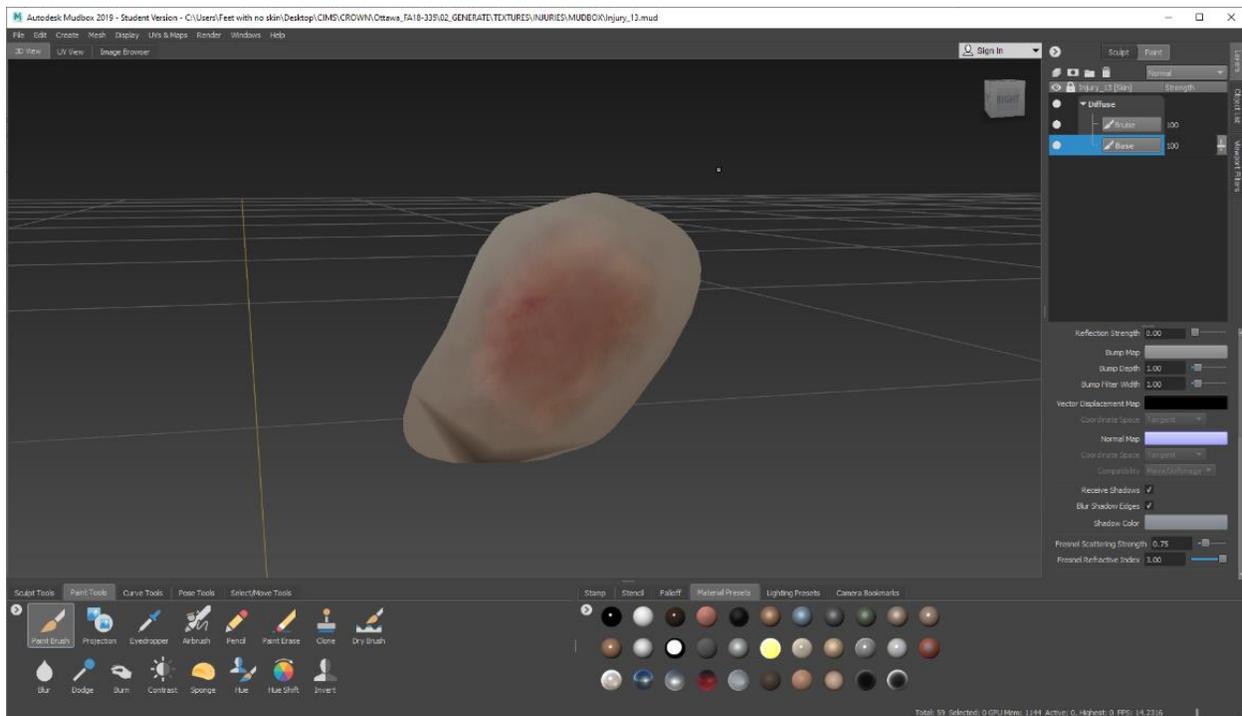
Creating Injuries

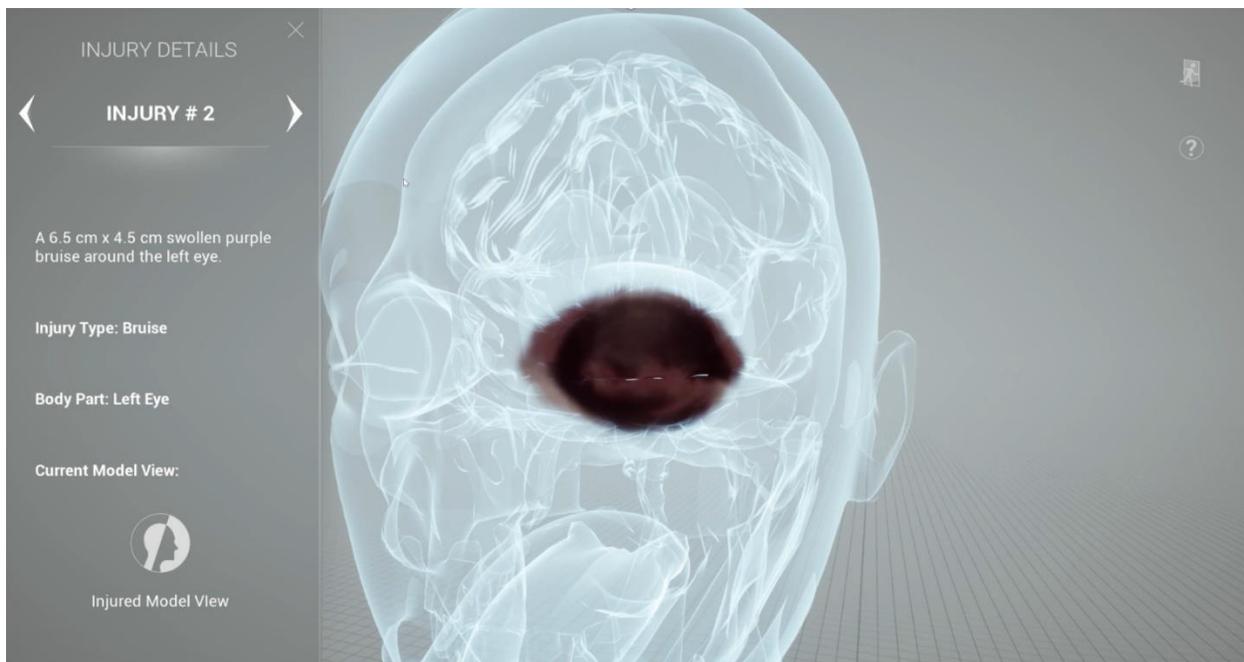
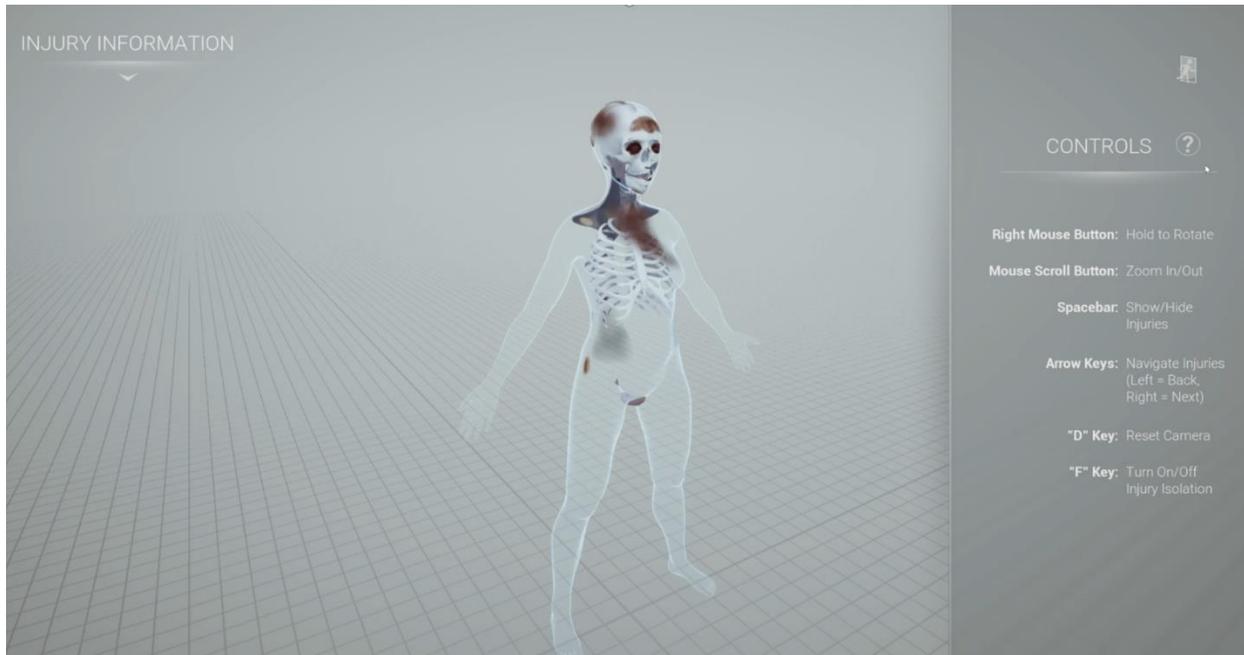
Once all base meshes were complete, it was time to create the injuries. Using the 'Project curve onto mesh' and 'Split mesh along projected curve' tools in Maya, injuries were drawn using the curve pencil tool in an orthographic view based on the reference photography provided by the Crown Attorney.



Texturing Injuries

Each individual injury cutout was brought into Mudbox for the texturing process. Using a paint layer with an alpha channel allowed the exported PNG texture to 'hide' the edges of the cutout mesh to appear seamlessly over the base mesh.





Building the Unreal Engine Application

Using Unreal Engine, a free-to-use, commercial video game engine, the lab crafted a custom viewing experience for the court. Utilizing a pre-made template and the Blueprint visual scripting system, CIMS was able to connect all of the injuries listed in the Excel sheet to each individual injury model and texture imported into Unreal. An easy-to-use navigation system was implemented for any juror to use. Special materials were made that could modify all injuries with the click of a button if a different visual style was needed.

