

# The Immersive Storybook Platform

Jim Henson's The Storyteller, the Seven Ravens by Felix & Paul Studios

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## ABSTRACT

The next step forward in Immersive Storytelling: Felix & Paul Studios, the leading immersive entertainment company with a celebrated track record in virtual reality, makes its first foray into augmented reality, through trackable objects in the form of a trackable storybook. The first project to be displayed on this platform will be the Jim Henson Storyteller series, with a new story adapted by Felix & Paul Studios called "The Seven Ravens," produced with the support of Logos: CMF, SODEC, EPIC Mega Grant, and Magic Leap.

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## 1 PROJECT IMPACT ON IMMERSIVE & AR

- It is the most ambitious AR project in length, narration and creative details. Through its narrative arc, it creates the most extended and engaged relationship you may have with AR as compared to other expressions like social media filters
- Unique tracking mechanism between Mixed Reality headsets and a physical articulated object, a book.
- An interactive project where storytelling takes precedence over technical elements, becoming an interactive story, pushing AR as a viable medium for storytelling
- Intuitive AR; The book is both controller and medium where you already know how a pop-up book should work, no directions are needed
- Tactile, you control the world in your hands vs. the plane existing on a fixed flat surface
- Includes physics-based and motion-based contexts; ie. when you pull the book to the left, the trees will bend and sway, tilt the book and feathers will flow away... running physics simulations on tableaus... water spilling off the book... rocks falling... lights swaying depending which way the book turns.

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## 2 TECHNICAL SPECIFICATIONS

- Multi-platform AR iterations:
  - Single user, head mounted: Magic Leap
- Future:
  - Single user, mobile: iPad
  - VR: Quest
  - Multi-user mixed head mounted & mobile

## 3 TECH INNOVATION DETAILS

### 3.1 Hyper ambitious requirements

Rendering an experience at 60 fps on a mobile-performing device. Isolate most of the CPU budget for tracking. Ensure robust tracking when the headset and book move independently with an articulated book... And occlusion happens (hands, motion blur or lighting artefacts). The tracking must respond precisely at the same frequency as the rendering. All in an as graphically-elegant as possible book!

### 3.2 Tech innovation = people

2 teams, 11 people total to develop the whole experience from the ground up in a studio that has never worked on real-time products. 1 team of mad scientists, focusing on R&D and core tracking technology, handling the CPU budget. 1 team of gaming developers, focusing on the real-time experience, handling the GPU budget. 1 game engine, Unreal Engine 4.

Several components developed over time to achieve our ambition, on the tracking side:

- (1) Tracking Module (core architecture and components)
  - Projective Geometric Algebra (PGA) to represent the Book and estimate poses
  - Border detection
  - Feature detection, identification and tracking
  - Page and Book pose estimation
  - Tracking interpolation and prediction
- (2) Standalone applications for recording, offline processing, tests, data mining and analysis
  - Ensuring fast iterations, disconnected from the experience
  - Record and track offline to introspect code and data
  - Cross platform (Windows, Mac, Linux, MR devices)
- (3) Build system, tracking pipeline and graphic design tools
  - (Almost) continuous integration of tracking module library and pipeline
  - Break apart graphic design
  - Validate feature detection and identification offline
  - Emit printable data, book specifications
  - Standalone tools to generate and validate markers for graphic designer

### 3.3 Key Challenges Overcome; Tracking, Fancy render targets, Tight performance budget and other hair pulling constraints

*How to overcome book occlusions?*

- Add double borders (black and coloured) to narrow down the feature research area. Add corners in the soup and potentially get 4 more tracking points “for free”,
- 5 markers per page, including 3 placed in potentially less occluded zones (by hands or motion blur),
- Pick a design occlusion-proof!

*Guaranteed perfect book representation at all times.*

- PGA helps calibrating the page positions and deduct an accurate complete book pose
- Interpolation and prediction to provide tracking feedback at same framerate as the rendering (tracking pipeline frame rate between 5 and 10fps)
- Grazing angles while page turn

- Compensate invisibility when book/pages are orthogonal to POV

*Each double-page must contain an entire world!*

- Up to 3 worlds displayed inside and outside the double pages, in full stereoscopy
- Custom stereoscopic render target system developed in Unreal

*Real-time rendering on Mobile-like performances.*

- Vulkan versus DirectX, more tolerant for draw calls
- Consolidate and merge assets as much as possible to reduce draw calls
- Review assets once built in engine to prevent overlapping
- Translucency is a challenge
- StandReduce complexity of rigs to handle performance constraints (very tight CPU budget)
- Post effect for stylization