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Storytelling and audience insights 2019
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Winning audiences for VR

Since September 2017, VR Hub has created diverse virtual reality stories across news, comedy, drama, events and history. Our VR has been showcased at Tribeca, SXSW, Future of Storytelling, Sheffield Doc/Fest and Venice Film Festival, winning multiple awards including the Rose d’Or award for VR; Raindance Best UK VR Experience; and Broadcast Digital Best VR Experience.

From our early research we knew that a lack of high-quality content and a cumbersome viewing experience were deterring mainstream audiences from enjoying VR. So the BBC VR Hub decided to focus on creating a small number of high-impact VR experiences with broad, mainstream appeal.

Our aim was to bring the best of BBC storytelling to VR. To do that, we have worked with teams from across the organisation including BBC News, Doctor Who, BBC Writers Room, BBC Rewind in Northern Ireland, BBC Proms, BBC TV Commissioning and BBC Research & Development along with some exceptional independent companies and artists. We wanted to use the BBC’s unique resources to create the most enthralling, powerful VR experiences imaginable that would excite the widest possible audience.

To that end, we launched a free VR app and took our content to over 160 libraries nationwide in our BBC Library VR tour.

Exhibitions at major venues across the UK and the world have also helped to make our VR accessible to wider audiences.

We also led the distribution of VR content from elsewhere in the BBC, which further added to our understanding of how audiences interact with VR.

Given the BBC’s credibility, along with its deep understanding of audiences, we were perfectly placed to help bring virtual reality into the mainstream in the same way the BBC led the introduction of early TV and radio.

With each commission, we targeted a specific set of audience needs and occasions, ensuring that each piece was compelling enough to make people want to put on a headset.

This has been a crucial learning experience for us. Even though audience insight research has underpinned much of our work, there are still no hard and fast rules for good VR.

Exhibitions at major venues across the UK and the world have also helped to make our VR accessible to wider audiences.

Whether the future is VR, AR, XR or some other form of extended reality, we are all now in the immersive age. Journalists, film makers and broadcasters have a fabulous new toolkit that can enrich their storytelling.

It has been a whirlwind 18 months, with three generations of VR headsets, the arrival of the Magic Leap AR platform, and the first VR Oscar was won by Alejandro González Iñárritu. We’re excited to see what happens next in this relentlessly fast-moving field.

This guide offers an overview of our work so far and shares some of the things we have discovered about creating high-quality VR on tight budgets.

Zillah Watson
BBC Commissioning Editor for Virtual Reality
and Head of BBC VR Hub

BBC Virtual Reality Hub
What makes a great VR story?

**VR is the best way to tell this story**
Make sure VR brings something to the story that can’t be achieved better with video, audio or text.

**The experience heightens ‘presence’**
That’s the sense that you’re really experiencing what’s around you – you’re a real person, in a real space and the world and the people in it react to you consistently and convincingly.

**There is an emotional charge**
VR is a great way to convey an emotional moment, a visceral feeling or a sensation. In our experience people are much more likely to remember this than dense information.

**The story is spatial**
Exploring the environment helps you understand the story. From what you see to the way you interact with the sound around you, being there helps you make sense of it.

**The viewer is more than a spectator**
The viewer is an explorer, not a disembodied bystander. They need a sense of agency and involvement – so give them a reason to look or move around and explore the world you create.

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**There’s a taste of the impossible**
Great VR takes you to a time or place you could never otherwise visit or imagine. You can meet people you could never meet or experience the world in an impossible way.

**It invites meaningful interactions**
Only add interactivity – beyond looking around – when the story really invites it. Misplaced interactivity is just distracting. Build in time to design, refine and experiment with any interactions.

**Go beyond the visual**
Just as with traditional video, having good-quality sound is crucial. In spatial experiences it’s even more important: well designed immersive sound can heighten presence and help convince viewers that this is really happening.

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The creation of a BBC VR Hub for virtual reality storytelling

**BBC VR Hub** was created as a multidisciplinary innovation team to spearhead the BBC’s exploration of immersive media for storytelling.

At its heart this has always been an insight-led project. Our strategy in terms of editorial, product development and distribution has been driven by an understanding of audience needs and the VR market. This has enabled a highly focused approach to innovation, where we built exactly what was needed to engage and grow our audiences.

By starting with identifying our audience and how we intend to reach them we can select target devices and design something in line with our budget. Making high-value VR on tight timescales and lean budgets has, at times, meant design constraints (e.g limits on top-end graphics and elaborate interaction). But by concentrating on strong stories (rather than games), these restrictions have ultimately framed the content – and in many instances become virtues.

Finally, maximising reach through touring work – be it in libraries, festivals, schools or museums – has steered us towards shorter running times which allow large groups to experience top-quality content and be left hungry for more.
Doctor Who: The Runaway

Step inside the TARDIS and become the Doctor’s unlikely assistant in this animated immersive drama.

VR Hub’s first major drama, The Runaway invites viewers to fly the TARDIS, wield the sonic screwdriver, and participate in the world of Doctor Who in a whole new way.

The brief was “five minutes with the Doctor” and at the heart of the piece is a spirited voice performance from Jodie Whittaker.

Core talent from one of BBC’s most famous brands have been involved throughout – including writer Victoria Asare-Archer and composer Segun Akinola.

Passion Animation Studios and director Mathias Chelebourg devised a 3D animation workflow based around a motion capture performance. This allowed them to find a striking new visual style for the show, which retains the weight and dynamism of real characters.

Following launch, the piece was toured at festivals, including Tribeca, as a bespoke installation featuring the TARDIS.

“Narrative, character and emotion have always been paramount in Doctor Who. They are core tenets of the show, so our VR piece had to be true to them and use them as the cornerstones on which we built. That way, the piece would feel like Doctor Who.”

Sam Hoyle
Co-Executive Producer, Doctor Who Series 11

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1943 Berlin Blitz

Join BBC reporter Wynford Vaughan-Thomas in the cockpit of a Lancaster bomber on the night of 3 September 1943, on a World War Two raid over Berlin.

1943 Berlin Blitz brought BBC radio archive to audiences in a bold new way. By placing viewers inside an authentic moment of history, a new level of insight and engagement could be achieved.

The team undertook painstaking research to reconstruct the mission in precise detail.

A collaboration between BBC VR Hub, BBC Rewind in Northern Ireland and Immersive VR Education, the piece demonstrated the potential for bringing unique BBC archive to VR.

1943 Berlin Blitz recently featured in the BBC2 series *Back in Time for School*, providing a visceral history lesson – and a vision of how history might be taught in the future.

This piece has toured local libraries across the UK and globally in museums and film festivals.

“To create the experience, the team gathered hundreds of photographs of Lancaster bombers and all of the original mission data in order to recreate the historic event. We recreated the mission with everything being historically accurate, right down to the smouldering Berlin landscape below.”

David Whelan
Director, 1943 Berlin Blitz
Immersive VR Education (IVRE)

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Lancaster bomber ‘F for Freddie’ flies over Berlin during a bombing raid in 1943 Berlin Blitz
Nothing to Be Written

Experience a musical and visual journey to the frontline, inspired by the poignant ‘field postcards’ written by World War One soldiers in the trenches.

Built around an original composition by composer Anna Meredith, Nothing to be Written became the first ever ‘BBC VR Prom’ in August 2018.

Director Lysander Ashton, of 59 Productions, approached the creative process in a similar way to opera design. Starting with a written score, visual aspects were created to fit the music.

The production couldn’t be completed until the premiere of Anna Meredith’s composition by the BBC Symphony Orchestra and National Youth Choir on the first night of the BBC Proms.

“VR is a useful tool for creating a sense of location and for taking audiences on journeys to impossible destinations. The piece allows you to be simultaneously deep in the trenches and in the hallway of a house back in England.”

Lysander Ashton
Director, Nothing to Be Written

Festivals and Awards

- Raindance Film Festival 2018 – Winner: Best UK VR Experience
- SXSW 2019
- Annecy 2019
- Sandbox Immersive 2019

Available on

- Oculus Go
- Vive Focus
- 360° version

BBC Virtual Reality Hub
‘Damming The Nile’ and ‘Congo’

Two BBC News VR series

Travel with a BBC news team as they embark on two geo-political and cultural journeys down the Nile and Congo Rivers.

*Damming the Nile* set a new precedent for VR journalistic storytelling. By embedding VR director Phil Harper with reporter Alastair Leithead and team as they shot the news story, a candid and vital new perspective emerged. This took viewers beyond the edge of the TV frame and into the story of a controversial new dam which is shaping the future of Ethiopia, Sudan, and Egypt.

Our second news series, *Congo*, expanded on this work in scope, taking an in-depth look at the vast and inaccessible Democratic Republic of the Congo. This was delivered across three episodes, as part of an ambitious, multi-platform story.

“Over the last 18 months, we set out to bring the latest VR technology to news and current affairs – to move beyond VR ‘experiences’ and deliver impactful, narrative news stories in VR. Africa was the perfect continent for this – with its stunning landscapes, its scope for adventure, its complex history and its relative inaccessibility.”

Alastair Leithead
BBC Africa Correspondent

**Festivals and Awards**

- Winner of Rose d’Or 2018
- Winner of IBC Innovation Award 2018
- Broadcast Digital Award Nominee 2018

**Available on**

- 360º version

“Viewers feel like they are part of the production crew”

Daily Mail, on *Damming the Nile*
Image from Congo VR series, filmed in a refugee camp in Kalemie.
Make Noise

Hum, sing and shout along with Nikki Amuka-Bird in this interactive virtual reality experience which uses the power of your voice to smash through the barriers faced by the Suffragettes. Created to celebrate the 100th anniversary of some women getting the right to vote in the UK.

Make Noise features original BBC archive of the Suffragettes.

An innovative game mechanic encourages the viewer to raise their voice to change the virtual world around them. Designed as a social experience, users break through their inhibitions and find their voices together.

Mesmerising, profound and playful, Make Noise empowers users to follow Emmeline Pankhurst’s advice and “make more noise”.

“Anagram found a unique art style which drew on the colours and imagery of the suffragette movement, but made it feel fresh for a new generation.”

Kim Nicholls
BBC Producer, Make Noise

Students test the power of their voice in Make Noise at a Fawcett Society event.

“The power of VR is creating a world where you can invite your participants in – not just their eyes but their whole bodies.”

May Abdalla
Director, Make Noise, Anagram

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<td>FOST Bridging the Divide Nominee 2018</td>
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<td>Amnesty Media Innovation Award Shortlist 2019</td>
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People Just Do Nothing

A punchy comedy kidnapping, filmed in a single shot with the stars of the BBC Three hit comedy.

Our first VR comedy took on the challenge of translating the comic phenomenon of People Just Do Nothing to the VR headset.

Written and directed by series director Jack Clough, it was soon clear that the cast’s innate chemistry and improvisational approach was a great fit for VR. Every muttered quip or awkward interjection is there to be spotted by sharp-eyed viewers.

“The whole piece plays out in one take – a singular moment in time in which the viewer ‘wakes up’ in their world. For it to work, the set-up, the set and the script would have to make use of the viewer as a character rather than just a passive viewer, so we worked closely with the amazing team at Roughcut to bring everything together.”

Phil Harper
VR Producer, People Just Do Nothing VR

Festivals and Awards

Broadcast Digital Awards Nominee 2019

Available on

☐ 360° version
Crossing The Sky

Trek to school with two sisters, on a perilous journey high in the Himalayas.

From the BBC World Service, this inspiring short film transports viewers to the girls’ home in the Himalayas. By meeting their family, and joining them on their dangerous walk to school – which includes a winch across a river – a deep human connection is forged.

“We wanted to take viewers to a place that is incredibly beautiful and yet hard to access, and inspire them with the energy and optimism of these two amazing girls.”

Anna Bressanin
Co-director, Crossing the Sky

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SELECT BBC VR PORTFOLIO

Missing Pictures

Meet major movie directors as they tell the stories of their great unfinished films that never made it to screen. With VR you enter their dreams.

Produced using a cutting-edge volumetric capture technique, viewers will be brought face-to-face with each director as explorable 3D scenes come to life around them, in a unique art style derived from storyboards.

Produced by Atlas V, in co-production with BBC and ARTE.

Director Abel Ferrera prepares to be volumetrically captured in a shoot for Missing Pictures

SELECT BBC VR PORTFOLIO

Atom to Orbit

An animated journey of sound and space from the smallest to the largest scales, with an original score by Hans Zimmer – for BBC Ten Pieces.

Atom to Orbit focuses on pushing the possibilities of new ‘WebVR’ techniques. WebVR is an accessible, browser-based form of virtual reality which has the potential to reach a wide audience, no matter which VR headset they have.

Atom to Orbit is the BBC’s most ambitious storytelling experiment with this evolving technology.

WebVR visuals for Hans Zimmer’s original score

BBC Virtual Reality Hub
Making VR

PRODUCTION & EXHIBITION
Shooting 360 for VR

There are clear challenges in shooting factual 360° VR video. The list of practical issues you discover is almost endless but the sooner these limitations are seen as unique features, the better your production will become.

With a team of four or five people and a busy shooting schedule, it’s vital to be pragmatic about how you’ll gather your material. For our films, we decided to make the team a key part of the story; that way our viewers could more readily come to believe they are there, on location, as part of the team.

To anthropomorphise your 360 camera with a human name – or in our case that of a cult robot, Marvin from The Hitchhiker’s Guide to the Galaxy – helps to focus your mind on how each shot could be composed.

Would Marvin choose to stand where the camera is currently located? Is Marvin being acknowledged within the scene?

To be ignored, especially in a factual format, invokes a strange ghost-like feeling in your audience – they feel as though they’re floating around but not really there. To be acknowledged, to be included, anchors your viewer to the scene, and that helps enormously with the immersion.

Traditional video journalism allows us to create sequences of images which together tell a story audiences instinctively understand, but we don’t really have this option in 360 video. Instead we’re inviting our viewer into a particular location and offering them a sense of something or somewhere. However, this limitation in story is actually the true power of 360 video, so it’s better to make good use of it rather than instinctively grabbing at sequences of shots. The power of the medium is in creating an experience for the viewer, so doubling down on that helps to really focus the production.

In Damming the Nile, our viewers took a monorail journey snaking around Ethiopia’s capital, Addis Ababa. With a crowded train of commuters in one of Africa’s fastest growing cities, there’s so much to look at, so many people, and so much going on that the scene can be watched back several times with new details revealing themselves with each new view. Shots like this are where 360 video can become almost magical, a total transportation to another reality far from home.

For this reason I believe slowing down your edit can really lift a 360 film, because it encourages you to make more of your visually engaging shots. Instinctively, it feels slow during the editing process, but when viewing it back on a headset those shots are significantly more engaging. When showing our films, we often heard the audience say, ‘I wish I could have stayed in that place a little longer’, so when it feels right, give them a really good chance to absorb an interesting shot.

Virtual reality is now a real option for storytellers who want to offer their audience an experience that brings them much closer to the story. A definite magic can be achieved which simply isn’t possible with other mediums, it heightens emotional engagement in the story and creates a more memorable experience. Yet reaching 360 video’s true potential isn’t a given and falling short in production value can create a frustrating, unsatisfactory experience. It requires a big production mindset, but the results are more than worth it.

(continues)
From a practical perspective, if your budget permits it, shooting in 3D is absolutely worth the effort. If the 3D in a particular scene is causing you problems during the edit, it’s always possible to drop it back to 2D, but where the 3D works it can add hugely to the overall experience. In our Congo film, we were able to capture silverback gorillas high up in the mountainous rainforest. After hours of trekking in pouring rain, it all came down to a frantic moment wrestling with Marvin to get him up and running as close to the gorillas as possible. In the moment we captured, the ‘presence’ of the gorillas can be keenly felt, and the 3D plays a big role in conjuring that feeling in the audience. When the gorillas instinctively stared back at the camera to assess if it was friend or foe, we knew we had captured something magical in which the medium of 360 was being used to its true potential.

Right: The crew hide from view during a 360° shot for *Damming the Nile*.

Marvin, the 360° camera, keeps cool with a hat near a waterfall in Ethiopia.

BBC Virtual Reality Hub
Since broadcasting began, reporters have found new ways to build up a vivid picture and create a meaningful connection between the audience at home and the complex, surprising and enriching stories of people around the world.

“360 footage eats hard drives. Your edit will be easier if you storyboard and aim for a low shooting ratio.”

Angela Crago and Zillah Watson, BBC VR Hub

When watched through a VR headset, 360 video gives the viewer the feeling of going to a place, and exploring it for themselves by breaking free from the narrow, directed eye. It lets them discover what they want to see.

In Damming the Nile, to enhance the sense of journey, we framed the story as ‘a trip with the BBC News team.’ This immersed armchair viewers more deeply in the adventure, and brought an authenticity and reality that’s vital for news.

This naturally led the correspondent to be the narrator, or guide, on the journey, and added a ‘behind-the-scenes’ layer to the piece. It also removed the need for the crew to be out of shot (often difficult when the camera has six all-seeing eyes), or for the tripods and drones patched out (Which would have been an ethical problem for a news story).

This relaxed tone – a bit more familiar and chatty than the usual news piece – gives the viewer the sense of a one-on-one experience. Audience feedback suggests it really offers them something new. While interviews with three water ministers might not sound like captivating VR – viewers have told us that the chance to see the whole shoot (and what was on the minister’s desk) actually made it an experiential highlight.

Alastair Leithead looks toward a 360 camera mounted on the prow of the boat on location in Ethiopia
The 360° VR edit

When it comes to the edit, 360 VR can feel like the troublesome cousin of normal film. The footage is often over 8K, it’s 3D and, before the edit even begins, each shot must be stitched.

For us, every project has been a technical and creative education. What follows are some of the simple lessons we’ve learnt for a smooth VR edit.

First and foremost: spend as much time as possible watching your shots in a headset. It sounds obvious, but it’s easy to get carried away and cut long timelines while gazing into a little rectangle on a flat screen. You can’t understand your shots this way.

We rely on regular lo-fi exports, which are easy to share across the team and spare your edit machine from being choked by real-time headset monitoring. It takes many pairs of eyes to properly review a 360 shot – as we discovered when we spotted a trouser malfunction in a film just hours before it launched!

We still find it essential to use a proxy workflow – usually starting with 4K proxies, and upgrading to 6K onlines at picture-lock. Be wary of non-VR effects plugins though, as some will struggle at massive resolutions, causing crashes.

When working on a big series with tight deadlines, we run two machines side-by-side, so allowing us to export patches, carry out 3D fixes in Mistika, and fine-stitch shots – all without pausing the creative process.

Effective sound design is vital in VR (maybe even more so than in 2D). As such, we prioritise an approach which allows for a creative back-and-forth between the spatial sound designer and the edit – usually via Vordio & Reaper.

On this note, we find a typical 2D voice-over is just too dense for VR. Lighter narration allows the viewer to immerse themselves in the sights and sounds of the locations you’re taking them to. “Three bullet points per scene” is our mantra. A more conversational tone helps too.

Finally, remember that the ‘finishing touches’ can really eat up time – even just placing text and astons. We allow up to a full day to get the finessing right.

It takes many pairs of eyes to properly review a 360 shot.”

Niall Hill
Producer, BBC VR Hub
Grappling with graphics

Virtual reality graphics are hard. A quick scan of VR titles shows many examples of graphics that lag behind the fidelity of traditional video games, Hollywood, and big budget TV.

The nature of VR means that we have to generate two images (one for each eye) at, ideally, more than 90 frames a second. This is easily double the workload of a traditional videogame. Failure to deliver enough frames, in time, and responsively to our user’s actions, can be a catastrophe of nausea, lost immersion, and people decrying VR.

And then there’s budget – everything you see in a VR experience has to be hand-crafted by an artist and optimised to meet the gruelling hardware demands – from the colour of the grass in *Turning Forest* to the audio interactions in *Make Noise*. This is not only time-consuming but also expensive.

Of course, 360 video is always an option. In this case, we get ‘photorealism’ for free but lose out on interactivity, spatial immersion, and stylisation.

How then do we create a groundbreaking, compelling experience for our audience on a budget, aiming at a mass-market mobile device?

**Fully baked**

In many of the VR Hub pieces we have aimed for distribution on mobile devices. This was driven by pragmatic business decisions; we felt that we could find a larger audience by doing this and tour the work to festivals, galleries and libraries much more easily if we had small headsets rather than large PC VR set-ups.

Alas, targeting mobile comes with many compromises, one of which is the kinds of ‘effects’ that can be achieved.

Large, visually rich environments with immersing effects such as dust motes or snow simply aren’t possible. However, in *Nothing to Be Written*, 59 Productions created exactly this on a mobile device by pre-rendering (or ‘baking’) large parts of the experience, while keeping key aspects interactive and real-time rendered, such as the letter that you can take hold of and move about. This mix of pre-rendered and real-time is a great way to bring high fidelity to mobile – but it has to be done with planning and care for it to feel seamless. (continues)
**Grappling with graphics (continued)**

**Photorealism doesn’t matter**
As the goal of photorealism in high-end graphics marches on, it may feel like this is the only way to create believable, exciting worlds for our audiences. However, stylisation and working within the bounds of technology can often bring out the best in a piece.

In *The Turning Forest* we were restricted by budget and the power of the target device (Daydream VR).

Using simpler assets allowed VRTOV to create a wonderful fairy tale that runs on a variety of devices, allowing the audio (the research for which was the initial driver for the piece) to shine.

**A cunning plan**
Producing a VR experience is prone to changes in direction and scope – it’s unavoidable. However, if you can plan in the restrictions from the start, you can minimise the impact on your project.

Creating assets for interactive experiences can be expensive, and changing interactions or narratives late in the process even more so. “Just changing the way the user can pick up that ball” could have a butterfly effect on lots of elements. Ideally hire a clairvoyant.

**Don’t forget the final hurdle**
If you plan to distribute via a platform such as Oculus, Viveport, Steam or PSVR, be ready for constructive feedback from your platform partners. They have rules and restrictions as to how well an experience should perform on the target hardware and, ultimately, hold the keys to distributing your experience on it.
Designing for new worlds

For those coming from a 2D background, there is no ‘frame’ or ‘canvas’ edge that you design within. The environments and objects you are designing can be all around you. This spatial approach provides different opportunities to direct attention and create hierarchies.

Environment is interface
The environment is not necessarily a background or context for the action, the environment itself can be part of the interface. Anything in your surroundings can become a point of interaction for the user.

Given that possibility, it can be hard to separate the content from the interface. Taking a playback interface as an example, in a 2D environment, invoking the controls would create an overlay on top of the content. If you are standing, immersed inside a story, there is no way to separate controls without stepping out of the experience. This presents interesting opportunities where parts of the setting can be used for control.

Nick Ritchie
User Experience Principal, BBC UX&D

Ergonomic challenges
Immersive experiences are more physical than other digital experiences. They often involve you standing up, looking around, moving your arms and walking around. In this respect, we need to approach the design of an experience like a product designer might consider designing a chair: we must consider the ergonomics of the experience. Will that be comfortable? Will that strain the neck?

Immersive = visceral
In immersive experiences, if things go wrong, there is the potential to make people physically sick or frightened; and it is also harder for the user to ‘exit’ the experience, all of which means there is more at stake if you make poor design decisions.

More ways to interact
Immersive experiences enable a greater variety of interaction patterns. We are no longer constrained to clicks or swipes – a full range of ‘natural’ interaction possibilities are at our disposal. Voice, movement and gaze can all be employed to create a more intuitive or unique experience.

Images: 59 Productions

BBC Virtual Reality Hub
# Prototyping

VR is still largely unexplored territory. This means that experimentation needs to be quick, easy and accessible.

Spatial prototyping allows us to take concepts rapidly from head to headset, and to see what parts of an idea work and what parts don’t. If you’re developing any kind of spatial experience, having a way to explore and play in that spatial world is invaluable – pen, paper and your imagination can only get you so far.

Prototyping is a key part of our development process because it allows us to quickly see whether or not an idea, technique or interaction has legs.

## Our method


Glitch.com is the Google Docs of coding; it lets you program online on your own or with a team of people and see each other’s changes as they type. There are templates to get you started and your project is instantly accessible via a link.

The natural partner for this tool is WebVR, the collection of technologies that allows you to build VR experiences inside web pages. There are a few different frameworks that help you create WebVR experiences, but in our team we have predominantly been using A-Frame.

The wide availability of web browsers on VR headsets (such as Oculus’s built-in browser, or Firefox Reality on other platforms) means that you can very quickly experience and share your work.

We find this workflow is great for getting ideas off the ground; taking projects to release is a different story.

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<td>Unity</td>
<td>Native code means the full power of headsets is available</td>
<td>Very steep learning curves</td>
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<td>Unreal</td>
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## Web-based frameworks and tools to build 3D worlds and experiences

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</tr>
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<tbody>
<tr>
<td>A-Frame</td>
<td>Good to quickly create shareable prototypes</td>
<td>Technology is still evolving</td>
</tr>
<tr>
<td>React 360</td>
<td>Gentler learning curves</td>
<td>Harder to create polished experiences</td>
</tr>
</tbody>
</table>

## Modelling and creation tools that you use within VR

<table>
<thead>
<tr>
<th>Modelling and creation tools that you use within VR</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blocks</td>
<td>Intuitive and natural</td>
<td>A good starting point but difficult to represent complex ideas and interactivity</td>
</tr>
<tr>
<td>Medium</td>
<td>A great way to sketch a spatial scene, setting or character</td>
<td></td>
</tr>
<tr>
<td>Tiltbrush</td>
<td>Good to use in combination with more complex tools</td>
<td></td>
</tr>
<tr>
<td>Tvori</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Physical modelling to represent 3D

<table>
<thead>
<tr>
<th>Physical modelling to represent 3D</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lego</td>
<td>Hands-on, low tech and fun</td>
<td>You can’t step inside what you make</td>
</tr>
<tr>
<td>Plasticine</td>
<td>Good for in-person discussions</td>
<td>Hard to share</td>
</tr>
<tr>
<td>Cardboard</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Using 2D to represent 3D

<table>
<thead>
<tr>
<th>Using 2D to represent 3D</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drawing</td>
<td>We all know how to do it</td>
<td>Until you try ideas in VR you can’t be sure your imagination matches reality.</td>
</tr>
<tr>
<td>Writing</td>
<td>Good to refine details or capture an overview.</td>
<td></td>
</tr>
</tbody>
</table>
Immersive sound

Spatial audio can be incredibly powerful. When a viewer’s eyes and ears experience a consistent sense of depth and scale, immersion is exponentially increased.

A good VR soundscape is very different from a traditional mix. Instead of mixing for a single perspective, you are creating a full 360 ‘soundfield’ – where every sound has a location in virtual space and the audio mix is tracked to the viewer’s head.

Choose the right mics and use them wisely

A-format microphones are the current go-to for 360 video. Mics like the Soundfield or Sennheiser Ambeo combine four-directional microphones to create a full spherical soundfield.

The A-format mic should be located as close as possible to the 360 camera (we usually place it directly underneath the camera where it is least visible to the lenses). Make sure to record the signal with a linked-gain recorder such as the Zoom F4, F8 or MixPre6.

To control the level of individual voices, we use lapel or ‘lav’ mics, or traditional mono microphones. These can then be panned spatially in the soundfield mix.

Don’t be afraid to mix big

While spatial mixes allow us to mimic reality, sometimes an accurate presentation of a soundscape through headphones fails to capture the feeling of being there.

In this case, it can be useful to over-accentuate the sounds – to create a hyper-real experience. Over-accentuating 3D reverb is often a good way to do this.

Don’t be restrained by what’s technically accurate – aim for what feels right.

(continues)
**Immersive sound (continued)**

**Game engines are a different beast**

Game engines like Unity or Unreal allow sounds to be attached to characters or objects in the scene. These sounds are then mixed dynamically relative to the position and actions of the user.

Free spatial audio SDKs by Google Resonance, Oculus and many others now allow excellent spatialisation and reverb.

Additionally, 360 soundfield ‘scenes’ can be used as background ambiances and for non-interactive elements.

**Deliver the right files!**

To master, we usually make a 16-channel, third-order master mix, plus a headlocked stereo track. You can make most other formats from these two master files using the FB360 Encoder app.

For delivery to standalone headsets, MKV matroska is recommended – this allows for the highest spatial resolution and high bitrate. Just be careful to test the file on your target headset – not all can handle it!

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360 camera with A-Format ambisonic microphone

Sounds in game engines can be attached to characters or objects in a scene.
The challenges of user testing VR

A lot of the user testing we did in VR Hub was rapid research – a small amount of planning, flexible schedules and ad hoc recruitment of participants. This is primarily because we would be weaving it in alongside ever-changing production schedules but also, rapid research has the benefit of being quick to set up and carry out. You can respond quickly to new problems or questions as they surface, and when done right this can be as insightful as a more thorough study.

Our experience user testing for VR presented us with some unique challenges:

**When observing**
You can’t always see what they are seeing (especially on mobile headsets): To solve this, I initially thought I might ask people to talk out loud but quickly realised how unnatural, and therefore unrepresentative those responses would be. When it comes to understanding people’s behaviour in VR, it is sometimes better to observe what people do, not listen to what they say, as the difference can be stark.

**When listening for feedback**
Separating content preferences from issues with the design or usability can be hard as they are intermingled. It’s not a problem exclusive to VR but one that is more emphasised since people are immersed in the story, their impressions of what worked or not can be influenced by whether they liked the content, and vice versa.

**When asking questions**
The flipside of the above point is that they also cannot see you so if you are asking questions or giving instructions, remember that your voice will appear disembodied in their virtual world, this can be disconcerting or break the illusion, it is probably better not to interrupt, rather wait until the session is over to talk.

**Entry/exit**
Unlike other media, when you experience VR you are fully immersed in the content. Going into this world can be daunting for some. Some feel self conscious that people are around and they cannot see. People can also be intimidated to come out of VR, not knowing who is around them, or experiencing a jarring sensation switching between modes. Try to ensure people feel secure and explain the steps of the process they will go through.

**Don’t forget the hardware**
Whilst it might not be in your gift to change, there are a number of usability issues to do with VR hardware. The struggles that people go though to get the headset on over glasses, get the right focus, or find buttons on the controller, can all leave an overall impression on people and affect their attitude towards your creation.

Nick Ritchie
User Experience Principal,
BBC UX&D

Thorough user testing pays off for high-profile events, like our exhibition of Doctor Who: The Runaway at Tribeca Film Festival

BBC Virtual Reality Hub
Things you need to know about running a VR production

1. **It costs more than you think**
   Production costs and a 20% contingency are only part of the story. To ensure your project is seen by a wide audience, you must re-version for different platforms, enter festivals, and ideally deliver immersive installations to international audiences. Expect to make many different versions of your marketing materials, and factor all of this into your staffing and budgets ahead of time.

2. **You will need plenty of ‘lawyer time’**
   There are currently no standard licencing or distribution agreements in VR – from museums to film festivals to commercial out-of-home experiences each will need to be negotiated separately.

3. **Rights clearances will be unpredictable**
   Can you clear for ‘world in perpetuity’? If not, will this hamper you in future distribution deals? Currently there are no mechanisms to collect percentage mechanical rights fees via the usual online stores – this will change in the future but, in the meantime, how are you going to manage this with rights holders? Is a buy-out a safer option?

4. **Credits will be long**
   People are even less likely to watch credits in VR than they are on TV! We usually reverse credit order, in line with the games industry – so the most important credits come first. We try to keep them as short as possible, and it’s worth considering having them ‘in the round’ rather than on a roller.

5. **You’ll have a lot of material to archive**
   We always include the final code base as a deliverable in our contracts. This ensures we have the flexibility to amend or port titles to new platforms if the originator is unavailable. It is also important for archiving – much like the rushes of a TV programme.

6. **Schedule additional time**
   Always add more time to your production schedule for sign offs with stakeholders, user testing of release candidates and submission to stores. Don’t underestimate how much time you will need for these later stages and last-minute fixes.

---

Angela Crago
Production Manager, BBC VR Hub

BBC Virtual Reality Hub
Location-based events

For BBC VR Hub, producing a piece of VR is only half the job. At-home headset use is still low and we’ve learned that if we’re going to reach our audience, we need to physically get out to them – wherever they may be. However, not every event will be right for VR and you should consider a few practicalities before you commit your time and energy.

Case Study #1: Royal International Air Tattoo

In July 2018 BBC & IVRE’s Chris Long took 6 HTC Vive headsets, plus high-spec PCs, to the Royal International Air Tattoo at RAF Fairford. With 150,000 visitors, scorching summer sun, and occasional thunderstorms, we found that exhibiting 1943 Berlin Blitz in an ex-Army tent was certainly not straightforward. We actually had great responses from audiences, but some extra foresight about kit, staffing, space and footfall would have saved us a lot of stress.

Practical Tips

Have a booking system or queue
Even when facing queues of up to 40 minutes, people were prepared to wait to see 1943 Berlin Blitz. Having a system in place improved our onboarding experience significantly. We also made sure to create time to chat with users after they took the headset off. This was particularly rewarding at RAF Fairford where the audience was specialist and highly interested in the content.

Take care of your staff
You’ll need roughly one staff member per two or three headsets, depending on their level of training and the complexity of the experience. And you’ll need someone to manage the queue. Remember to allow time for breaks!

Consider your location
Beyond creating a safe, open space for your users, is it practical? Are you indoors, kit and users protected from the elements? Do you have access to power? Is the space quiet enough to hear the VR? Train stations and air shows may not be ideal, but anything is possible if you prepare!

Kim Nicholls
Producer, BBC VR Hub
Case Study #2: South by Southwest Festival 2019

In the spring of 2019, BBC and 59 Productions showed *Nothing to Be Written* at SXSW. The piece is an orchestral and visual story of the ‘field postcards’ sent home by soldiers during WW1. The challenge was to establish the context of the piece – WW1, the trenches, and the experience of British families – for an international audience.

**Practical Tips**

**Set the scene**

We’ve found that creating a visual ‘set’ for a location-based event can go a long way to increasing engagement. By recreating an old postal sorting office, SXSW users were engaged and immersed in the history before they even put on the headset.

**Give them something to talk about**

VR is still a very individual experience, but hopefully something everyone will want to share. By providing a Twitter hashtag, users had the opportunity to share feedback of their experience at SXSW. The set came into its own here providing a great backdrop for photos – generating intrigue that wouldn’t have been possible otherwise.

**Have enough headsets to generate buzz**

When planning BBC events, we like to have multiple headsets to reach the widest possible audience. Where possible, we also display the current viewer’s experience on a large monitor – allowing those who don’t try the VR to see what it’s all about and join the conversation.

Users watch *Nothing to be Written* on a ‘set’ designed by 59 Productions to look like an old postal sorting office at SXSW 2019.
How do audiences feel about VR?

What visitors to BBC VR pop-ups in over 160 libraries have told us

From April-June 2019, the BBC ran a Virtual Reality Library Pop-Up tour across the UK in over 160 libraries. There has been a boom in location-based VR experiences, and the commercial world has identified that, for now, this is where audience opportunities lie. But rather than putting VR in shopping malls or arcades, we needed to find locations that fit BBC public-service values. With UK public libraries, we struck gold.

From our qualitative research we found that VR’s unique impact is in creating emotional, memorable connections with places and events. Participants didn’t remember more detailed information but they reported feeling deeply connected with the places they (virtually) visited. As a springboard to learning, VR has real potential. After watching Congo VR, 83% of viewers said they would go on to watch a full-length documentary about the country.

Learning from audiences

We wanted to know more about how audiences feel about VR, if they’re ready for it or even interested. Libraries Connected helped us set up Library VR showcases that allowed us to gather this kind of data. Libraries encouraged all VR participants to fill in our online survey. We followed this up with in-depth telephone interviews to find out what they remembered a month or so later.

Our findings – from 1700 survey responses and 20 follow up interviews (each an hour long) – provide a rich resource for anyone thinking of making VR and getting it to audiences.

The good news for VR creators is that 96% of those who filled out the survey found BBC VR enjoyable, 91% immersive and 93% original.

Word of mouth

Some 92% of the survey respondents said they would talk about the BBC VR Pop Up with other people. Meanwhile the social media amplification has been huge: the tour has featured in around 600 tweets, reaching well over 800,000 users – regular library users and more.

The research shows those who visited a BBC VR pop-up in a library are three times more likely to recommend it to a friend or family member than any other out-of-home VR experience (ie commercial VR in shopping malls or VR arcades). The combination of the library environment and the BBC brand have proved to be a powerful draw.

(continues)
How do audiences feel about VR? (continued)

Libraries in charge
The BBC licensed content, loaned headsets, supported with training and troubleshooting, and provided suggested marketing resources. But it was librarians who ran the pop ups. Their enthusiasm, understanding of their communities, and commitment to the role libraries play drove this project to success.

We originally asked libraries to get as many people into headsets as possible. But instead of concentrating on footfall, librarians pushed out headsets to as many local branches as possible. BBC VR popped up in even the smallest, most remote parts of their network – from “Knit and Natter” clubs through to prison libraries, reaching all ages. This had a fantastic result, reaching deep into communities the BBC rarely connects with.

Fully interactive vs 360
If VR is to go beyond its exclusive festival niche, the industry needs to tap into routes to broader audiences. Quality storytelling on lower-end headsets allows you to reach real people in their communities. The library project offers a template for how that can succeed. We know that people don’t understand how great VR can be until they try it. Persuading audiences to take that first step and put on a headset has been a big challenge for VR makers. For over half of our library VR users, this was their first chance to try VR. BBC VR libraries pop-ups are helping break down these barriers.

“I never thought I’d end up in the Congo when visiting the library”
Visitor, Newport Library

“They were literally sitting there, manically texting their friends saying get down here and you don’t often get teenagers texting their friends to come to the library”
Slough librarian

Over 160 local libraries across the UK ran BBC VR pop ups.
**BBC Survey Results**

96% of users found BBC VR enjoyable *

85% of users want to see more VR in libraries*

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Lancashire libraries @lancspublib - Jul 12

"Fantastic."
"I have never been on anything like this before."
"I really felt like I was in the plane."

Some of the feedback from our #BBCVR Berlin Blitz experience.

Thank you @ShirleyMannman and @BBC

Watch this space for more Virtual Reality sessions in our libraries.

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Rachel Benn @rchalesto - May 29

Thank you BBCVR for bringing new experiences and most importantly lots of laughs to our lovely group members @SouthLeedsLib!

Shirley experienced the Congo VR and came up close with Gomitas. First time experiencing Virtual Reality and absolutely loved it. ^^ @wincsbridge

---

Oldham Libraries @OldhamLibraries - Jun 1

Who doesn't enjoy some Saturday #VR? We had a great time with the #BBCVR @bbcdoctornwho experience. More soon! 🎥 @novellibraries - At Oldham Library & Lifelong Learning Centre

Rachel Bennett @rchalesto - May 29

More VR this evening with @SouthLeedsLib @SouthLeedsLibraries. The response has been fantastic. Jean said she hasn't had the opportunity to escape Brexit in the last 5 years, so to be able to visit the Congo with Virtual Reality was amazing! 🎭 @digitallearning @opportunities @bbc

---

Library Kawau Academy @kawauacademy - Jun 29

Amazing, great, terrific, surreal, shocking, emotional, excellent, factual, awesome - one word description of the #VirtualReality history experience @kawauacademy. V grateful to the librarian Jackie for nonstop explanations for this fantastic day! @library @BBC @kawau*

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*BBC Survey Results*
LOOKING AHEAD

What’s next?

An exciting future.

One of BBC VR Hub's aims has been to underpin great content with research. This has led to a number of collaborations with research partners including at UCL and the University of Barcelona. This research has hinted at just some of the exciting implications for the technology going forward.

In particular, two research projects published with Professors Mel Slater and Anthony Steed in *Frontiers in Robotics and AI* explored the impact of enhanced user ‘presence’ and ‘embodiment’ on recall of and subsequent interest in a factual story.

The results were striking: having virtual characters directly acknowledge the viewer (enhanced presence) and giving participants a virtual body (embodiment) both significantly increased the likelihood of viewers seeking further information about the story. Embodiment also showed measurable enhancement of the viewer’s recall of depicted events.

For the BBC this is particularly interesting. If VR provides more memorable experiences than other media, and helps people to engage more deeply with world events, it could be important in serving the BBC’s mission to inform, educate and entertain.

And this is just scratching the surface. Augmented reality is another area we are exploring, where experimentation is already beginning to pay off. The BBC’s app *Civilisations* put cultural and historic artefacts from around the world into the hands of viewers, and received significant acclaim. Our prototypes for the Magic Leap headset have been building on this promise.

As VR and AR headsets become lighter, easier to use and more affordable, we can hope that the unique powers of immersive storytelling will become ever more accessible, and bring powerful new stories to all audiences.

BBC VR Hub is wrapping up now but we are confident that good VR storytelling can delight audiences young and old.

BBC Virtual Reality Hub
BBC VR Hub team and BBC partners

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Commissioning Editor
BBC VR Hub

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BBC Research & Development

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BBC Research & Development
Thank you to everyone who has worked with us in the BBC and beyond – too many to list, but you know who you are. For all your support, insights, advice and inspiration, we are grateful.

FURTHER READING

Find out more

For more information about all BBC VR Hub projects and behind the scenes films, visit www.bbc.co.uk/vr

Presence and Engagement in VR


Audience Research in VR

1943 Berlin Blitz at the Royal International Air Tattoo
Miller, C. (2018, Aug 30). Progress in VR: when the content is more interesting than the technology. BBC Academy.

Financing and Distributing VR

VR for News: The New Reality?

Other suggested reading
Intro to Shooting 360

Experience on Demand by Jeremy Bailenson

Immerse
Immerse is a website focused on creative discussion of emerging nonfiction storytelling. www.immerse.news

BBC VR Hub and BBC Writer’s Room Workshop

Thank you to everyone who has worked with us in the BBC and beyond – too many to list, but you know who you are. For all your support, insights, advice and inspiration, we are grateful.