Summary Impact and White Paper to UK Government

WinkBall	ViewTalk	QR Touch TV
		

V9

2020

Developed by WinkBall IGRN

Summary of the impact

This report describes impact from James Ohene-Djan's research on personalisation, assistive technologies for the deaf, and web-based video. The research led to two spin-out companies:

(i) Viewtalk was started by Ohene-Djan in 2008 in partnership with Deafax, a charity dedicated to access for people with impaired hearing. Viewtalk developed video messaging specifically tailored to the needs of the UK's nine million deaf and hard-of-hearing people.

(ii) WinkBall was developed in partnership with a privately-owned UK news organisation (Correspondent Corporation). Winkball provided a system that enabled users to post video content for specific audiences and purposes. At its peak it employed 300 reporters to supply dedicated content, and generated a user community of 150,000 active content-generators and three million video watchers.

The report also contains the technical details of the latest development as a white paper submitted to the UK Government

Research underpinning WinkBall and ViewTalk

James Ohene-Djan is a senior lecturer in the Computing Department at Goldsmiths, having been appointed originally as lecturer in January 1999. He has been employed here continuously except for a short break in his contract from May 2000 to January 2001.

The research started with Ohene-Djan's PhD (completed in 2000 at Goldsmiths, supervised by Alvaro Fernandes, now at Manchester) on usability of web-based systems; this is summarised in [1]. The PhD provided, we believe, the first formal specification and definition framework of a complete set of functions for personalisable, adaptive hyperlink-based user interaction with hypermedia. Ohene-Djan defined an architecture, data model, manipulation language and set of interaction modes that were later to provide the framework for the Viewtalk and Winkball systems.

Viewtalk: Ohene-Djan developed his research, investigating how to enhance social communication for people with hearing impairments. His analysis of their needs led to the development of a video-based communication system (Viewtalk) that could be used interactively in educational contexts to enhance students' learning. Viewtalk was equipped with features that facilitated the use of sign language in videos; it also utilised a range of social media technologies such as instant messaging and `chat' systems [2]. It is an online video sharing platform, requiring no specialist software or hardware, enabling users to record and post video blogs, conduct video conversations, and participate in sign-language based role-plays. The site hosts videos by dedicated reporters on sport, current affairs, education, arts, and the learning of British Sign Language. Developing Viewtalk involved working collaboratively with the deaf advocacy charity Deafax and with members of the deaf community to design the interfaces and functionality, iteratively, through participatory design methods [3]. This research, for example, led to insights on how to incorporate affective information with no sound and digital representations of sign language [4].

Transport for London approached Ohene-Djan and Viewtalk to find out how video could be used to communicate road safety information to deaf people, especially children. Ohene-Djan, working in collaboration with the police and deaf advocacy groups, developed a video information system for Transport for London; this used Viewtalk technology and is still a part of the Viewtalk system [5].

WinkBall: The HCI research undertaken in relation to Viewtalk, and also in the underlying software architecture of that system, formed the foundation for the development of a larger system for "different-time, different-place" video communication for more general audiences: Winkball [6]. This built on the technologies used in Viewtalk and provided additional features to enable the formation

of online communities using private video walls and blogs. It allows controlled multi-level access to video.

The predominant new research problems that needed to be solved to move from Viewtalk to Winkball concerned scalability. The robustness and scalability of the system was tested and developed through a series of real-world deployments. The most extensive of which was during the 2010 FIFA World Cup in South Africa, when over 100,000 real-world WinkBall users simultaneously accessed over 80,000 videos which were recorded and uploaded during the tournament over a 40 day period. Users from 40 different countries help test the robustness of the system through multi-user video message sending, real-time video blogging, and posting on community video walls.

Winkball was able to meet that demand (and subsequently much greater demand: it now stores over 3 million videos) through Ohene-Djan's development of (i) a number of innovations in software architecture for web-based video systems and (ii) a new multi-processing video transcoding system that encodes video from a range of sources and formats. The architecture details are not published since they are commercially confidential, but they are the subject of two international patents (see section 5, reference [1]).

Summary of impact

In 2011 Ohene-Djan spun Viewtalk off into a business, offering completely free access to members of the deaf and hearing-impaired community and commercial marketing services to companies interested in engaging with that community. Organisations that have used the Viewtalk service [2] include the London Zoo, John-Lewis Partnership, Heathrow Airport, and the Science Museum [2,6,8]. Since 2009 the deaf advocacy charity Deafax has promoted Viewtalk as a means of creating multi-media information resources. As well as providing media for the deaf and hearing-impaired community [6], Viewtalk also provided employment for members of that community: at its height, Viewtalk had 20 employees, 13 of whom were deaf or hearing-impaired [5].

The benefits of Viewtalk have been recognised by experts in education, social cohesion, and social policy. This is evidenced in a set of video interviews incorporating sign language with the following people: Sabine Iqbal, UK Founder of Deaf Parenting [5]; Malcolm Bruce MP and Bob Russell MPs members of the All-Party Parliamentary Group on Deafness; Eva Fielding Jackson, trustee for the British Deaf Association; Paul Enales, Chief Executive Officer of the Anti-Bullying Alliance; Paul Simpson form the British Association of Teacher of the Deaf (BATOD); Tom Fenton, Chief Executive Officer of the Royal Association for Deaf People; Ines Sleeboom Van Raaij, President of the European Congress of Mental Health; Catherine Forry, Founder of Deaf Advocacy and Justice 4 Deaf People; Lord Michael Heseltine, former Deputy Prime Minister. Paul Simpson of the BATOD typifies responses to using the system: *"Viewtalk is a great example of a British university producing an assistive technology that really goes to the heart of what's needed for young deaf people today. It's innovative and uses the Internet to communicate which is essential."* [2]

Five secondary schools from across the UK participated in a pilot project, during the period October 2010 and July 2011, which enabled pupils to make videos on a range of school and community topics. Teachers reported positive effects on pupils' communication, teamwork, organisation, presentation, self-confidence, leadership and time management. Examples of children's work can be found on the ViewTalk webpages [2]. The Principal of Donaldson's College, Scotland's national educational centre for people with special hearing and communications needs, said: *"Viewtalk will offer ... opportunity to deaf people for getting support and I am really delighted to be taking part in promoting that."* A second project, which trialled the use of Viewtalk in two special needs schools, received lottery funding of £10,000 in July 2011. The project had 32 student participants, 55 parent participants, 20 teachers and 5 volunteer psychologists. Measured outcomes identified that 90% of students had a positive experience of using the Viewtalk technology and 42 parent respondents stated that Viewtalk was the most advanced technology their child had used successfully. The Deputy Head of a Special School, Berkshire, Reading, stated that: *"the pilot project had measurable benefits in increasing their understanding of how technology can be used with Special Needs students".*

In evaluating the pilot, Dr Berry Billingsley, Associate Professor in Science Education and parent of a child with Autistic Spectrum Disorders (ASD), and Dr Cathy Tissot, Specialist in ASD, noted that the technical and communication skills of the pupils had increased and given everyone concerned more confidence to engage with video online communication for educational purposes. The project was successfully completed in April 2012 [7].

WinkBall was established as a company in 2009. It had a turnover of £2.5 million a year for 3 years, a staff of 60 full-time employees [8], 300 interim reporters (in the UK, the US, India and South Africa), and an active user group of 150,000. At the end of this 3-year period, the specified objectives of WinkBall had been achieved in terms of technical advances in video content creation and multi-user, large scale access. From July 2012, the WinkBall project was scaled back so that focus could be given to the development of new technologies for mobile video communication using the WinkBall infrastructure. This work is currently underway. From August 2009 to July 2012, 3 million videos were uploaded to WinkBall and there were over 30 million views [3].

A wide range of organisations have found WinkBall an effective part of their communications strategy and became paid clients [4]. Clients have included Visit Britain, Transport for London, Crossrail, London Development Agency, London Ambassadors, LOCOG, The Mayor's Office, the Greater London Authority, Sony Music, Sky Sports, William Hill, Zurich, Jeep, Daily Telegraph, Shell, Disney, Sky Bet, and The Sun. Innovative campaigns such as Transport for London's Barclays Cycle Hire Launch, the Olympic London Ambassador's Launch, Sony Music's Why Music Matters campaign and WinkBall's Faces for the Forces campaign led to WinkBall being nominated Finalists for several major industry awards, including the Marketing Week Engage Awards 2010, the Chartered Institute for Public Relations Awards 2011 and the PR Week Awards 2011 [4].

WinkBall ran several high-impact international campaigns [3]. For example, "Faces for the Forces" enabled the public to send a million video messages of support to the UK Armed Forces in Afghanistan was conducted annually between 2009 and 2011. Brigadier AT Davies MBE at HQ, Joint Forces [9] sent a letter of thanks to Winkball and the project was publically endorsed by David Cameron. In another example, 500 candidates in the 2010 UK general election used WinkBall to communicate with voters in the "Do You Know Who You're Voting For?" campaign from January 2010 to May 2010 [3]. Working in collaboration with the United Nations and the Hoping Foundation charity, WinkBall helped commemorate the 20th anniversary of the year of the Child and the 60th anniversary of the creation of UNRWA by using video technology to connect 500 United Nations schools in Palestine, Syria, Jordan and Lebanon, during the period June 2009 to August 2010, enabling 50,000 school children to record video messages expressing their hopes and dreams for the future in an online video yearbook [10].

In 2010, 80,000 videos were recorded that provided a unique insight into the hopes, dreams and events of the first African nation to host a World Cup. The impact was recognised at the highest level within South Africa, with the High Commissioner of South Africa, Dr Zola Skweyiya personally inviting Ohene-Djan to present the WinkBall video content and technology to all of London's African Ambassadors and High Commissioners who were invited to a reception at South Africa House on 23rd July 2010. Dr Zola Skweyiya stated that: "In a million years I can't describe what this tells you in five minutes about South Africa". Niall Wilkins, First Secretary Political, South African High Commission, stated that the WinkBall video archive and technology "truly captured the legacy of the 2010 FIFA World Cup", and was an important record for the South African nation. He stated that: "I am going to speak to a friend of mine in the Presidency about this". The WinkBall archive was donated to the University of Capetown and the South African Tourist Board [3].

Sources to corroborate the impact
All the materials listed below are available on request, in hard or electronic format, from Goldsmiths' Research Office.

1. Patent for Video Communication System; Inventors: Duncan Barclay, James F. Ohene-Djan. Pub. No.: US 2012/0017254 A1, Pub. Date: Jan. 19, 2012. SPC Class: 725115, PCT No. PCTGB09/51343;

Patent for Content Distribution System; Inventors: Duncan Barclay, James F. Ohene-Djan. Pub. No.: US 2012/0188331 A1, Pub. Date: Jul. 26, 2012. IPC8 Class: AH04N715FI, USPC Class: 348 1408, PCT No. /GB2010/05129.

2. WinkBall/Viewtalk Showreel can be seen here Here
3. Key website descriptions and URLs for Viewtalk and WinkBall are listed here.
4. The WinkBall project press archive contains detailed information on all print, online and video press.
5. WinkBall Industry Finalist Awards
6. Viewtalk: examples of educational work
7. The Viewtalk press archive
8. ACCT Through WinkBall & Viewtalk
9. Sales summary, list of staff and R&D Tax Relief Claim for Viewtalk and WinkBall are here
10. Faces for the Forces: video content and sample press coverage.
11. Press coverage for WinkBall UNRWA Schools project; examples include:

- BBC Click, the BBC's flagship technology programme on BBC News 24, included a review of the WinkBall project by Kate Russell; first broadcast 06/11/09.
- Sky News interviews Ohene-Djan about the WinkBall project nationwide campaign *Faces for the Forces*; first broadcast 05/11/09.
- CNBC interviews Ohene-Djan as the example of the future of the internet as part of its series *The Internet Turns 40*; first broadcast 29/10/09

Technical Details of System Development submitted to UK Government

2019 Detailed Technical Descriptions

Introduction

IGRN started development in June 2016 following a period of consultation with a marketing and brand agency that informed the short and long-term objectives of the company.

IGRN identified a market gap as well as a lack in corresponding technology solutions, In response to the well known disruption taking place in the world of publishing and rich content production, namely video content.

IGRN's management, brought together an experienced team of experts in computing, programming, design, TV and video production, as well as technical support specialists in order to undertake the task of creating products to bridge the 'gap' in this sector.

The company was formed with the specific intention of creating and operating a marketplace for video content, matching production to business, brands, sponsors and publishers, with professional content creators. A series of web-based software platforms were developed so as to offer users access to services beyond the limits of physical space.

The primary platform known as the 'hub' offers multiple skillsets required of content creators, to be brought together in the process of content creation, in the form of a defused network.

The platform contains built-in workflow management, scheduling, work-sharing and up-loading software, allowing rapid creation and delivery of video packages known as 'reports'. These 'commercial/consumer' video reports are of broadcast standard.

IGRN created several interconnected distribution platforms, namely a public platform and a B-to-B platform in the form of a news-wire.

Background

The effect of digitalization, internet, high-speed data the proliferation of self-generated content and mobile technology has both created opportunities as well as major problems for the media industry.

The disruption of traditional structures and methods has particularly affected the advertising industry and particularly the profession of journalism, reporting, filming and broadcasting. Further problems have emerged around the issue of context relating to content.

'Brand safety' is particularly important to all organisations and the existing public 'highways' for digital content, namely video, have become cluttered with digital 'noise' and mixed messaging. The proximity of random and often damaging, self-generated content, accessed through social media and public platforms has created a serious problem for digital publishers and marketing agencies.

Furthermore, third party platforms tend to function on a model, whereby the publisher surrenders the corresponding advertising space to the carrier. Thus they lose control of the related messaging and any possibility to leverage the content to generate revenue.

IGRN recognised from the start that video, would become the principal means of communication in the 21st Century and set out to re-invent the production methods and cycle and to create an entirely new method of functioning for media professionals, business marketers and digital video publishers, in order to offer the profession a more relevant and tailored solution.

IGRN development of interactive media on the web is set apart from the other forms of media on the web by its emphasis on user led activity, location centric services and custom built video processing and distribution systems.

The company thought to fill a vacuum they believe existed within traditional channels of digital media distribution and communication. This included IPTV, YouTube, Facebook, Twitter, messengers, web based magazines, journals, newspapers and a number of other web services. IGRN also recognised the limitations of traditional TV platforms in the creation and delivery of flexible services for brands.

From the desire to find a novel way of content distribution and delivery WinkBall project was spawned. IGRN envisaged many of the current inefficiencies and inherent problems have developed within the media landscape and, in response created highly complex eco-system to facilitate the processes for the diverse actors within this sphere.

Currently there is no such product exists on the market.

The following report acts as a continuation of its last R&D claim for period ended 31 March 2018 and outlines examples of the advances and technological uncertainties encountered by IGRN technical team during the development of their WinkBall platform and various subsystems and services.

R&D boundaries

The focus of this R&D claim and supporting technical information is on the qualifying R&D project that was undertaken by IGRN in the accounting period ended 31 March 2019.

The boundaries of the R&D activities are the design and development process undertaken by IGRN in order to establish a stable release of the final technological solution. This involved iterative phases of design, testing, coding, prototyping, load testing and refactoring.

The qualifying costs associated with these activities are the cost of IGRN's permanent technical employees. Additionally the cost of externally provided workers who were technical and necessary to develop the software products that IGRN were trying to develop. Along with items consumed or transformed, software licences and utilities. No qualifying indirect activities have been included in the claim. All commercial activities for promotion and business have been excluded from the claim.

IGRN has identified non-qualifying projects and development activities that involved routine work, fine tuning and minor bug fixing that did not contribute towards any technological advances or involve any technological uncertainties. These activities have been excluded from the R&D claim.

Non-qualifying activities are straightforward or routine activities which do not contribute to the resolution of scientific or technological uncertainty and/or advancement. Some examples of ineligible activity undertaken by IGRN are:

- Software development involving the application of ‘‘patches’’ or undertaking minor enhancements to existing systems. This can also include solution development that uses known algorithms and code templates available in the public domain or infrastructure software development that does not seek to achieve an appreciable improvement via the resolution of technical uncertainty. These will not be eligible and are excluded from the claim.

- Integration/development project challenges which are resolved by purchase and vanilla implementation of vendor software into the enterprise IT environment. Especially when there is little or no technological uncertainty regarding the interaction of the software with the other enterprise system components, the activity is not considered eligible R&D. Additionally, enhancing processes or software performance by simply adding another ‘‘entity’’ is not considered eligible activity unless there is deemed to be a significant degree of technological challenge in designing the process or integrating the hardware.

- Maintenance of existing stably deployed enterprise software in which no development activity takes place beyond minor upgrades and changes to the application.

Technological Advances

During the qualifying period, IGRN sought to achieve technological advances in the processing and delivery of video content via embeddable web-based TV channels specifically in the development of architecture that can support processes and functionality via a single access point.

The achievement was to integrate the entire WinkBall platform with a suite of internally developed tools and sub-systems. The Web TV channels needed to play sequential video clips in a seamless fashion, to be stitched together along with externally sourced content, such as advertisements and branded artwork.

Furthermore the Channels, known as ‘Touch TV’ are fully searchable and sit within listings of related channels. The entire listing can be shared across all digital and mobile channels and are accessed by a single URL.

The unique ability to build ‘live broadcast’ channels in real time provides a unique mechanism to create relevant and relational content.

The architecture has been put in place to support very large quantities of video content in context, paving the way for A.I. driven personalization and bespoke messaging.

The advances sought were beyond the current knowledge in the field.

R&D project advances have fallen broadly into the following categories, but were not limited to:

- A Channel maker application;

A system was required to allow the creation and maintenance of web TV Channels. A set of tools and techniques had to be developed in order to meet company’s requirements for an easy to use and cost effective solution, which can be scaled and remotely available for multiple clients. The channel maker had to be integrated in already developed WinkBall platform.

- WinkBall TV Channel Player;

WinkBall realised the requirement to deliver the channel content in a cross-browser video player, which will feature programme navigation within a specific channel. Also will enable users to change the channels if enabled by the owner. Social media integration and interactivity were a vital part of requirements.

- HotSpot/Advertising Overlay technology;

The company required a way of overlaying customer information at specific points within the video. As well as presenting static information such as adverts, we wanted to support dynamic data capture at key points during playback. This data could be aggregated and reported back to the channel owner.

- Live TV feature;

Typically, when viewing video content on the Internet, the user is presented with a player that begins playback from a given video start point - usually time 0. However, WinkBall wished to create a sense of Live TV and ensure that each time a channel is accessed it would play back from a unique position related to the current local time.

Technological Uncertainties

WinkBall’s developers were uncertain how to deliver and integrate new channel maker software into existing platform so that existing media assets can be used safely in the TV Channel environment without any side effects.

IGRN's competent professionals were uncertain in how previously developed components will be integrated together into the WinkBall platform and what combination of existing techniques, processes, software or new systems would need to be developed to ensure that the final solution would meet the requirements set. Furthermore, as this technological solution would be based on untried methods, there was an underlying risk of failure due to system uncertainty.

The uncertainties included, but were not limited to:

- A Channel Maker application;

After researching off the shelf possibilities, it was clear there was nothing on the market that can be used for our purpose. The main obstacles were the cost and integration difficulties. The channel content would need to conform to stringent formatting rules in the quality of presentation. Also, we were uncertain how to feed our existing back catalogue into the channel maker.

A channel editor or producer would need to select optimal clips from a various sources (external/internal) when compiling the channel.

Further research into the matter has concluded following requirements for the channel maker:

1) Ability to import and create programmes from various sources, which included internal and external sources with various formatting standards and quality levels;
2) Multiuser management of channel owners and produced assets. These include the studio work, existing reports, interviews and external sources such as YouTube videos;
3) Audio and video quality should be normalised across all programmes that complete a channel;
4) Timeline creation and the ability to add, remove or rearrange video sequences;
5) Preview facility to test and adjust playback arrangements;

- WinkBall TV Channel Player

IGRN's developers were uncertain whether it would be possible to achieve all the features requirements for the channel playback on standard HTML5 video player. Further into research it has appeared that extra modules have to be built on top of the standard video player. Team was uncertain how the whole future set can be implemented and maintained across different browsers. The compatibility and uniformity have represented a huge challenge.

We required a unique approach to the problem of video loading and initialization and were not sure where we can achieve the same performance across various browsers and mobile devices.

- HotSpot/Advertising Overlay technology

Team was uncertain how to ensure HotSpot feature is highly interactive and not obtrusive. The developers were not certain what data to include in the model and how to manage and layout content. Other major issue was the player and channel management integration.

- Live TV feature

IGRN's developers were uncertain whether the Live TV feature will have positive impact on user experience. Potentially, there was a risk of loosing part of our user base. This could have a negative impact on our revenue stream.

Work Done

IGRN undertook an iterative agile software development approach to try and realise its objectives. Considerable effort was made to support a consistently large volume of users from the outset and develop cross-platform support for our products.

A Channel Maker application

Development of this tool using web technologies was the obvious choice. We could leverage a dynamic and modular interface supporting authenticated access using HTML/CSS and Javascript. Due to the complexity of the requirement, it took several iterations and redesigns before a coherent and simple to use interface emerged.

A channel editor or producer would need to select optimal clips from a larger selection when compiling the channel. We established a mechanism for a channel bucket whereby one department e.g the Studio would upload provisional content to be viewed and selected from later. These uploads were categorized for easier management. All Items added to a channel had to be of uniform format yet were emanating from a number of sources. For this reason we had to factor in a trans-code mechanism for uploaded media files ensuring each was standardized before being added to a channel.

We researched existing options for manipulating video sequences but realized we needed to develop something bespoke. To save time and development costs we used an existing javascript library and re-purposed it to work with video. Channels can contain many dozens of clips so alternative timeline views were developed to support easier management

At any time in the channel creation process, a channel editor would require to preview the whole channel of just the section they were working on. We developed a preview system invoking the whole channel creation compilation process that didn't affect the currently saved state. We developed the math to calculate 'cut in points' allowing an editor to preview channel sections.

WinkBall TV Player

This presented significant technical challenges as each clip exists as a discreet video file. There is a maximum limit on the number of simultaneously open videos that a standard web page can handle so preloading all videos was not an option. Research and development was required enable videos to be pre-loaded in manageable numbers and have the transition between them done via CSS.

We required a unique approach to the problem of video loading and initialization. It was decided to use a 'queued list' method whereby a predetermined number of players would be held in a logical list with only the central most item being visible at any time. As the channel was traversed, the next or previous nth video would be 'side-loaded' off-screen, in the background whilst the visible video played. Triggers were implemented to detect end of video playback whereby the list would be shuffled left or right with the visibility of the central video being switched to the next or previous player.

As this approach used CSS to switch visibility instantly, we ensured invisible loading of channel programmes and created the user experience of uninterrupted television playback.

An additional problem related to the timing and positioning of the playback position when shuttling through videos. We conducted research and development of quite complicated mathematics to determine the landing or playback position in a video, relative to it's start point, calculating it from the percentage of the overall channel playback position.

This was required to work in a bidirectional fashion allowing shuttling backwards and forwards. This work created a novel player, unique to WinkBall with loading and initialization features significantly extending the standard implementation.

Live TV feature

Having investigated different techniques we decided to develop the math to rotate channel playback from the beginning of the hour.

When a user loads the channel, a calculation is made on basis of the local time to determine the number of total channel loops that fit wholly within the current time from the beginning of the hour. The total length of all the loops is subtracted from the current time to give a unique channel playback position. We believe the development of this system creates a new type of viewing experience for web content and is unique to WinkBall.

Enhancement of video delivery - Implementation of HLS

A sideline in research we'd been conducting revealed that we could optimize video delivery and cater for situations where bandwidth was low or variable. The technology was based on the use of HLS or HTTP Live Streaming. By re-engineering our platform to work with this format we could achieve the following:

1. Support improved delivery to mobile devices - by encoding uploaded videos in several different quality versions, we could use HLS to auto detect bandwidth and make the necessary adjustments to use the most appropriate video streams.
2. We could re-engineer the player to use a single video object in place of the queue. This greatly simplified the implementation. However, we encountered problems due to imprecise frame timing and had to create new math to deal with frame counts whereby shuttling forwards and backwards was efficient and predictable.
3. Simplification the resultant playlist using a unique system of pre-compiling a channels master playlist from the combining of smaller programme specific lists. The simplified playlist would also allow CDN compatibility if we ran into scalability problems and required outsourcing of delivery.

We re-engineered the system back end to cope with HLS format creation. We had to ensure every item added to a channel had been processed and implemented mechanisms for this.

Such was the increased load on our transcoding server that during the update we needed to research, spec and purchase new hardware. We investigated and integrated GPU processing technology to vastly speed up video processing.

We developed new software to create a master HLS playlist from the compilation of the smaller channel segment files. We customized the HLS standard with our own specification whereby we could include proprietary timing information in the playlist to trigger our own events such as HotSpot popups and adverts as described later.

HotSpot/Advertising Overlay technology

We required a way of overlaying customer information at specific points within the video. As well as presenting static information such as adverts, we wanted to support data capture at key points during playback. This data could be aggregated and reported back to the user.

We spoke with potential users to define a minimum set of requirements that would be flexible enough to cover all envisaged use cases. We realized we needed a proprietary solution as it needed tight coupling to both the Channel Maker and the player.

We enhanced the Channel Maker to support the creation of ad-hoc overlays in a variety of formats including popup and slide-in methods.

We created an interface allowing custom form creation and the ability to specify the presentation time value.

The ability to capture ad-hoc user input required research of a novel method using the JSON format to allow capture of any combination and format of information. The technique meant we were free from the requirement for database schema creation which would lock us into specific data formats. Our solution is flexible, scalable and allows to us to interface with as yet undefined external client systems.

For the purposes of GDPRS we researched and implemented an authentication system that generates an email. This is sent to a user when they complete a HotSpot entry, seeking their permission to use the data and validating their identity.

We developed the appropriate player and database modifications to trigger and display the HotSpots as per the parameters set in the channel maker.

Subtitling

Annotating our video content was a requirement from certain users. It would be impracticable and too expensive to manually subtitle all our content. We required an automated solution.

We researched online solutions for voice recognition. Many were inadequate due to low quality recognition. Even the best meant that automatic processing was only partially feasible and required the creation of a subsystem to handle user intervention by way of an offline manual error correction system. This was researched and implemented.

Another issue was the specific method of subtitle integration. There were options for including the text directly in the video stream or to hold it externally from the video and integrate it at load time using the HTML 5 player attributes to specify a file location. We opted for the latter as it allowed us to develop the error correction system. Subtitle text could then be maintained in a variety of languages and updated at any time, independently from the programme or channel.

Summary

IGRN has widened the scope of its WinkBall platform by adding bespoke Channel Maker and channel Player to existing ecosystem.

This was a continuous process of implementing, developing and refactoring aspects of the platform to eliminate any bottlenecks that reduce performance and compatibility with new features.

Currently, WinkBall platform development is still on-going with several technological milestones yet to be delivered.

Research undertaken by IGRN established that there were no existing products capable of fulfilling the requirements necessary to achieve seamless WinkBall platform integration and in particular channel making and channel delivering systems.

Therefore IGRN was obliged to undertake the work itself and come up with novel and innovative ways to solve the arising issues at considerable risk, however, the dedication and skill of the management and IT specialists has developed and delivered a ground breaking platform that continues to push the boundaries forward in this field.

2020 Detailed Technical Descriptions

Introduction

IGRN Ltd development of interactive media on the web is set apart from the other forms of media on the web by its emphasis on user led activity, location centric services, custom built video processing system and QR codes video integration.

IGRN identified a market gap as well as a lack in corresponding technology solutions, In response to the well known disruption taking place in the world of publishing and rich content production, namely video content.

IGRN's management, brought together an experienced team of experts in computing, programming, design, TV and video production, as well as technical support specialists in order to undertake the task of creating products to bridge the 'gap' in this sector.

The company was formed with the specific intention of creating and operating a marketplace for video content, matching production to business, brands, sponsors and publishers, with professional content creators. A series of web-based software platforms were developed so as to offer users access to services beyond the limits of physical space.

The primary platform known as the 'hub' offers multiple skillsets required of content creators, to be brought together in the process of content creation, in the form of a defused network.

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IGRN development of interactive media on the web is set apart from the other forms of media on the web by its emphasis on user led activity, location centric services and custom built video processing and distribution systems.

The company thought to fill a vacuum they believe existed within traditional channels of digital media distribution and communication. This included IPTV, YouTube, Facebook, Twitter, messengers, web based magazines, journals, newspapers and a number of other web services. IGRN also recognised the limitations of traditional TV platforms in the creation and delivery of flexible services for brands.

From the desire to find a novel way of content distribution and delivery WinkBall project was spawned. IGRN envisaged many of the current inefficiencies and inherent problems have developed within the media landscape and, in response created highly complex eco-system to facilitate the processes for the diverse actors within this sphere.

The following report acts as a continuation of its last R&D claim for period ended 31 March 2019 and outlines examples of the advances and technological uncertainties encountered by IGRN technical team during the development of their WinkBall platform and various subsystems and services.

R&D boundaries

The focus of this R&D claim and supporting technical information is on the qualifying R&D project that was undertaken by IGRN in the accounting period ended 31 March 2020.

The boundaries of the R&D activities are the design and development process undertaken by IGRN in order to establish a stable release of the final technological solution. This involved iterative phases of design, testing, coding, prototyping, load testing and refactoring.

The qualifying costs associated with these activities are the cost of IGRN's permanent technical employees. Additionally the cost of externally provided workers who were technical and necessary to develop the software products that IGRN were trying to create. Along with items consumed or transformed, software licences and utilities. No qualifying indirect activities have been included in the claim. All commercial activities for promotion and business have been excluded from the claim.

IGRN has identified non-qualifying projects and development activities that involved routine work, fine tuning and minor bug fixing that did not contribute towards any technological advances or involve any technological uncertainties. These activities have been excluded from the R&D claim.

Non-qualifying activities are straightforward or routine activities which do not contribute to the resolution of scientific or technological uncertainty and/or advancement. Some examples of ineligible activity undertaken by IGRN are:

6) Software development involving the application of ‘‘patches’’ or undertaking minor enhancements to existing systems. This can also include solution development that uses known algorithms and code templates available in the public domain or infrastructure software development that does not seek to achieve an appreciable improvement via the resolution of technical uncertainty. These will not be eligible and are excluded from the claim.

· Integration/development project challenges which are resolved by purchase and vanilla implementation of vendor software into the enterprise IT environment. Especially when there is little or no technological uncertainty regarding the interaction of the software with the other enterprise system components, the activity is not considered eligible R&D. Additionally, enhancing processes or software performance by simply adding another ‘‘entity’’ is not considered eligible activity unless there is deemed to be a significant degree of technological challenge in designing the process or integrating the hardware.

· Maintenance of existing stably deployed enterprise software in which no development activity takes place beyond minor upgrades and changes to the application.

Technological Advances

During the qualifying period, IGRN sought to achieve technological advances in two distinct areas. A: developing a complex cross-platform multi-channel player. B: implementing a system to automate the use of QR codes in combination with video.

The principal objective of A: was to provide the ability to play multiple channels of video as subsets of a particular thematic. For example to be able to have multiple actors represented via individual channels, within a particular industry or sector. Or, to display searchable categories of video content within a vertical.

Particular attention was placed on providing a workable and repeatable user interface that can serve multiple sectors.
These include: education, local government, charities, retail and arts.

The principle objective of B: has been to successfully integrate ‘Quick Response’ codes with the ubiquitous use of video in order to close the gap between the ‘physical space’ and rich digital media.

QR codes have become the standard mechanism by which a digital packet of information can be launched, leading to an action such as a purchase or a download. By connecting QR codes with video a user can ‘scan’, watch and action a process on-the-fly, creating a vital bridge for digital services that are otherwise complicated to access.

By embedding QR codes in video, services are offered on live TV and a link is created via smartphone allowing the user to watch, scan, and action a purchase or download.

Sectors impacted by this technology include: healthcare, publishing, retail and advertising.

The advances sought were beyond the current knowledge in either of these fields.

R&D project advances have fallen broadly into the following categories, but were not limited to:

- The creation of a multi-channel ‘back-end’ system to up-load and manage multiple data streams, to catalogue and organise relevant video into playable sections.
- To provide the ability to generate and embed video in multiple categories ‘on-the-fly’.
- A system to generate QR codes in-sink with video and to embed the QR codes within a program automatically.
- To create physical QR codes and a smartphone platform that is customisable, supports video and points to e-commerce software.
- The ability to alter information and destination URL’s on an on-going basis without changing the physical QR code.

R&D project advances have fallen broadly into the following categories, but were not limited to:

4. A multi-channel management system;

A system was required to allow the creation and maintenance of web TV Channels. A set of tools and techniques had to be developed in order to meet company’s requirements for an easy to use and cost effective solution, which can be scaled and remotely available for multiple clients. The channel maker had to be integrated in already developed WinkBall platform.

5. WinkBall TV Channel Player;

In the past, IGRN realised the requirement to deliver the channel content in a cross-browser video player, which will feature programme navigation within a specific channel. Also will enable users to change the channels if enabled by the owner. Social media integration and interactivity were a vital part of requirements. In addition, the player features information panel that can show a QR code and various data about current channel and the owner.

6. Adaptive QR code system;

The company required a way of overlaying customer information at specific points within the video. As well as presenting static information such as adverts, we wanted to support dynamic data capture at key points during playback. This data could be aggregated and

reported back to the channel owner. On top of already implemented features in HotSpot system support for dynamic QR codes was added at different levels of abstraction, e.d. channel, programme, banner/hotspot.

Typically, QR code images are static media. However, WinkBall wished to add a feature which would enable to change the behaviour of QR redirects dynamically.

Technological Uncertainties

IGRN's competent professionals were uncertain in how previously developed components will be integrated together into the WinkBall platform and what combination of existing techniques, processes, software or new systems would need to be developed to ensure that the final solution would meet the requirements set.

WinkBall's developers were uncertain how to deliver support for multiple channel verticals and integrate support for multiple skins into existing channel maker software so that existing media assets can be used safely in the TV Channel environment without any side effects.

Furthermore, as this technological solution would be based on untried methods, there was an underlying risk of failure due to system uncertainty.

The uncertainties included, but were not limited to:

7. A multi-channel management system;

After researching off the shelf possibilities, it was clear there was nothing on the market that can be used for our purpose. The main obstacles were the cost and integration difficulties. We had to deliver solution that would support Apple TV, Android TV and web platforms end enable delivery of our content for different clients using multiple user interfaces and branding.

The channel content would need to conform to stringent formatting rules in the quality of presentation. Also, we were uncertain how to feed our existing back catalogue into the new system.

Further research into the matter has concluded following requirements:

1) A management of channels within various skins for multiple clients;
2) Multiplatform support for channel deployments using particular skin settings;
3) Subtitling and translation with ability to edit and correct AI generated files in the channel maker;
4) Preview facility to test and adjust playback arrangements;
5) Ability to add a QR code to a channel, a programme or a HotSpot;
6) Add dynamic redirects to QR code so the destination URLs can be changed according to a metadata settings;

8. WinkBall TV Channel Player

IGRN's developers were uncertain how to add new features to the existing WinkBall Channel Player so it can support new requirements and be backward compatible with the existing channel delivery system. Further into research it has appeared that extra modules have to be built. The compatibility and uniformity have represented a huge challenge.

We required a unique approach to the problem of video loading, initialisation and network bandwidth. Developers were not sure where we can achieve the same performance across various delivery platforms.

9. Adaptive QR Code System

Team was uncertain how to ensure the already implemented HotSpot feature can be adapted for QR codes and still remain highly interactive and not obtrusive. The developers were not certain what data to include in the model and how to manage and layout content.

Other concerns were around integration of QR Codes into channels and programmes as per new requirements. It wasn't clear when and how to display the codes and what priorities to give at different level of abstraction. There was a risk of loosing potential users if the QR codes became close to another form of banner advertisement with performance impact on the channel playback.

Work Done

IGRN undertook an iterative agile software development approach to try and realise its objectives. Considerable effort was made to support a consistently large volume of users from the outset and develop cross-platform support for our products.

A multi-channel management system

We already had a basic channel management system but required integration of the Adaptive QR code system. The challenge was to integrate it with minimal changes to the existing UI which had already incurred considerable investment to develop.

The first implementation associated QR codes with specific channel segments (programmes). This required a modest addition of a QR button to the existing segment display. All the UI for managing the QR code metadata such as title and additional information for the landing page skin was developed inside a 'modal module' meaning it could be reused wherever in the system we were displaying the programme.

This approach had a drawback, however. If a user required a QR code not to point to a programme but instead to some other external link, for example, a customer website, there was no 'parent' object to relate the QR code object to. This required development of a new section of the channel management system to allow an association of a QR code to the Channel and not the programme. The corresponding back end work is described in the next chapter.

Work was undertaken to implement the new section as a new page, decoupled from the existing implementation. QR codes could now be created relevant to a particular channel and need not necessarily point to a programme. All the QR codes for a particular channel were now listed and specific management facilitated via the existing 'modal module'.

To satisfy the requirements of Dynamic/Adaptive codes, the modal management module was modified to incorporate a list of one or more 'Redirects'. A date/time calendar facility was added to allow scheduling of redirects and a fallback implemented so the Channel URL would be displayed in the event of 'no match' when filtering Redirect threshold parameters. The UI took some time to refine and its development is on-going.

As part of the work on the channel management system, the team have conducted extra research and development on Subtitling feature. Improved user interface and batch processing enabled support for multiple translation of the same audio stream. The solution was using combination of AI external services to produce auto-generated subtitles with ability to manually edit them later on for broadcast quality.

WinkBall TV Player

The team has realised that the current implementation of the WinkBall player had its short comings and stability issues across some platforms and the current architecture was not flexible enough for new features to be added.

The decision was taken to re-build the player from scratch using as a base VideoJS platform. The team took iterative approach to build a modular version of the player with all the extra features as per requirements specification. The player built is also backward compatible with our delivery platform for channels and programmes.

In previous player version we only supported one subtitle track at the time. The new version is able to load multiple language tracks from our system.

The player also supports new QR code delivery and can also have different look and feel depending on the client requirements. New behaviour and information can now be added to the player. This includes but not limited to company information, channel description, logo, configurable click-through buttons and static QR codes.

Adaptive QR Code System

As Developers, we faced two key challenges regarding the intended use of QR codes.

The first involved how to link a QR code to a specific section of a video stream. Typically QR codes represent static URLs that load a webpage hosted on some web server.
We had been tasked with setting up a system allowing a user to specify at a given section within a video channel, a QR code to link directly to that position.
When scanning the code with a phone for example, the corresponding video should load and play from the predefined start position.

Given the urgency of the requirement and the scope of our resources, we required a solution built on our existing implementation.

Our first strategy involved incorporating the offset time of the required position into the URL contained within the code. This worked but had a major drawback.

Subsequent editing the channel from the time the QR code was created would frequently invalidate the time values of previously created codes making the system unworkable. We needed an alternative approach. A way to guarantee the validity of the URL and its encoded information even after extensive modification of the channel.

Realising that every programme within the channel was represented with its own unique id, we adopted a new approach whereby the start position of each programme was recorded along with its id. This occurred each time the channel was saved. We would then encode the programme id into the URL. Upon reading the URL, our server would extract the programme id and perform a lookup to ascertain the programmes current start position.

This allowed channel editing to continue after the creation of the QR code, ensuring the correct start position each time a reference was made. The new strategy slightly increased granularity of the start positions available, reducing them in number and meant codes had to correspond to the starting programme locations. A compromise but justified by the improved flexibility in being able to maintain the channel without invalidating the generated codes. We also encoded information relating to what particular visual skin was to be loaded with each code.

The second challenge was how to allow for an entirely new target URL to be reached even though the QR code was statically encoded into an image and could not change once created.

Another way of describing this was as a requirement to reassign different programmes to the same QR code and allow switching between them.

We called this requirement, implementation of 'dynamic codes'. We envisaged a solution that would require extensive back-end development.

First, we generated a QR code as a URL containing a unique id. The unique id would never change and be stored in the DB along with the current programme assignment. The assignment could be changed at any time. Upon a code being read and its URL resolved, the server would interrogate the DB, lookup the id and retrieve the final URL. We would then use URL forwarding to return the correct destination to the user.

The solution worked well but did require manual intervention when a QR code destination was to change.

For truly dynamic QR codes, we had to go one step further and allow automatic reassignment based on some arbitrary information such as time of the day, date, or the number of times referenced.

Some of these codes would be displayed in media such as videos or magazine articles. Therefore the reader or consumer of the QR code could be in a variety of different geographical locations. We were to factor geolocation into the algorithm for programme selection (URL target) for a given code. We could then display information in response to reading a QR code, specific to a users location.

After considerable research and debate, the developers concluded another approach and a DB schema enhancement was required. We developed and modelled the concept of a QR code "Redirect". By assigning one or more Redirects to a QR code, and assigning trigger thresholds to each, it was now possible to have a fully automated system where the location e.g programme a particular QR code referenced, was determined entirely automatically and based on a readers local information such as date, time and geolocation.

Summary

During this qualified period, IGRN has built on top of its WinkBall platform by extending and improving existing products and by adding bespoke adaptive QR code system.

This was a continuous process of implementing, developing and refactoring aspects of the platform to eliminate any bottlenecks that reduce performance and compatibility with new features.

The development of the WinkBall platform is still on-going with several technological milestones yet to be delivered.

Research undertaken by IGRN established that there were no existing products capable of fulfilling the business requirements necessary to achieve seamless WinkBall platform evolution. In particular, research and development were concentrated around adaptive QR code system, multi-channel management platform, subtitling and new channel player.

Therefore IGRN was obliged to undertake the work itself and come up with novel and innovative ways to solve the arising issues at considerable risk, however, the dedication and skill of the management and IT specialists has developed and delivered a ground breaking platform that continues to push the boundaries forward in this field.

2021 Detailed Technical Descriptions

Introduction

IGRN Ltd is known for its development of user-led, interactive web-based video/smart TV platforms and dissemination of video. Its back-end functionality is unique in its emphasis on user-led, organised content creation and workflow tools.

The company was originally formed with the specific intention of creating and operating a marketplace for video content and various, vertical Multi-channel Players were built and operated in specific areas, including academia, the arts and the consumer sectors. The platform contained built-in workflow management, scheduling, work-sharing and up-loading software, allowing rapid creation and delivery of video packages known as ‘reports’. These commercial/consumer video reports were of broadcast standard, designed to carry advertising.

Since March 2020 IGRN has been deepening its core development around its custom built ‘QR enabled’ video processing system and web TV platform in order to be able to provide clients with their own ‘QR video’ interface platforms.

IGRN’s management, brought together an experienced team of experts in computing, programming, design, TV and video production, as well as technical support specialists in order to undertake the task of turning software systems that were originally built for its internal business, into stand-alone products.

Background

IGRN set out originally to address the disruption of traditional structures and methods that had particularly affected the profession of journalism, reporting, filming and broadcasting in relation to advertising and delivery mechanisms and in the face of user-generated content platforms and social media.

The effect of the global pandemic on digital media accelerated the requirement for all business to embrace internet video as a means of internal communication but has also forced an emphasis on external communication for marketing and sales purposes. Nearly all business, government and third sector have now become content generators and disseminators.

Much of what has been traditionally achieved in the physical space has now to be achieved digitally. Particularly in the areas of marketing, communication, and retail. It became clear to the founders of IGRN that the tools that IGRN had created were well suited for businesses and organisations to transition.

Having fully integrated the use of Quick Response technology and video, IGRN's systems allow a digital journey to take place from the launching of video via smartphone from a physical space via QR code, to single, multiple integration with video content platforms and all the way to embedded actionable QR hotspots that are viewable on any digital device and can, in turn, be read by smartphones. Thus the full entire commercial cycle is completed.

The challenge for IGRN was to turn its IT platforms into external client accessed products to meet demand. The work undertaken at IGRN in this field is unique and comes directly from our background in creating mass communication video technology and having the expertise in managing the creation and dissemination of millions of contextualised video clips under the consumer brand 'WinkBall'.

The following report acts as a continuation of its last R&D claim for period ended 31 March 2020 and outlines examples of the advances and technological uncertainties encountered by the IGRN technical team during the development of their platform, products and various subsystems and services.

R&D Boundaries

The focus of this R&D claim and supporting technical information is on the qualifying R&D project that was undertaken by IGRN in the accounting period ended 31 March 2021.

The boundaries of the R&D activities are the design and development process undertaken by IGRN in order to establish a stable release of the final technological solution. This involved iterative phases of design, testing, coding, prototyping, load testing and refactoring.

The qualifying costs associated with these activities are the cost of IGRN's permanent technical employees. Additionally, the cost of externally provided workers who were technical and necessary to develop the software products that IGRN were trying to create. Along with items consumed or transformed, software licences and utilities. No qualifying indirect activities have been included in the claim. All commercial activities for promotion and business have been excluded from the claim.

IGRN has identified non-qualifying projects and development activities that involved routine work, fine tuning and minor bug fixing that did not contribute towards any technological advances or involve any technological uncertainties. These activities have been excluded from the R&D claim.

Non-qualifying activities are straightforward or routine activities which do not contribute to the resolution of scientific or technological uncertainty and/or advancement. Some examples of ineligible activity undertaken by IGRN are:

- Software development involving the application of ‘‘patches’’ or undertaking minor enhancements to existing systems. This can also include solution development that uses known algorithms and code templates available in the public domain or infrastructure software development that does not seek to achieve an appreciable improvement via the resolution of technical uncertainty. These will not be eligible and are excluded from the claim.
- Integration/development project challenges which are resolved by purchase and vanilla implementation of vendor software into the enterprise IT environment. Especially when there is little or no technological uncertainty regarding the interaction of the software with the other enterprise system components, the activity is not considered eligible R&D. Additionally, enhancing processes or software performance by simply adding another ‘‘entity’’ is not considered eligible activity unless there is deemed to be a significant degree of technological challenge in designing the process or integrating the hardware.
- Maintenance of existing stably deployed enterprise software in which no development activity takes place beyond minor upgrades and changes to the application.

Technological Advances

During the qualifying period, IGRN sought to achieve technological advances in two distinct areas.

- A: evolving a complex cross-platform multi-channel player with dynamic QR codes integration

- B: implementing a QR Video Management System.

The principal objective of A was to build a multi-channel player solution that can provide support for dynamic QR videos within a programme, a channel or an application that consists of groups of channels.

For example, in the beauty industry, a QR video player can be used as a full marketplace where each brand can be represented via an individual channel or group of channels within a single video player. The end user would be immersed into an interactive TV-like experience and brands would be able to create QR Video action links. Linked QR Codes can also be used on physical objects, for example, product packaging, magazines, beauty sample sets etc. The player will also support marketplace wide search.

Particular attention was placed on providing a workable and reusable interface that can serve multiple sectors.
These included: education, local government, charities, retail and arts.

The principal objective of B was to create a platform that integrates the entire WinkBall suite of tools and subsystems with QR Video codes. The new QR Video management system should have unique abilities to build a QR Video Application that consists of arbitrary groups of channels, programmes, hotspots, banners and dynamically created QR Video Codes. The system should also allow to create, share and print labels which can link ‘physical space’ and rich digital media.

QR codes have become the standard mechanism by which a digital packet of information can be launched, leading to an action such as a purchase, a download, a video playback, a feedback form,

etc. By connecting QR codes with video, a user can ‘scan’, watch and action a process on-the-fly, creating a vital bridge for digital services that are otherwise complicated to access.

By embedding QR codes in video, services are offered on live TV and a link is created via smartphone allowing the user to watch, scan, and action a purchase or download.

Sectors impacted by this technology included: charities, healthcare, publishing, retail and advertising.

The advances sought were beyond the current knowledge in any of these fields.

R&D project advances have fallen broadly into the following categories, but were not limited to:

7) **QR Video Management System**

A system was required to allow the creation and maintenance of existing TV Channels within vertical boundaries of different applications together with an adaptive QR code system. A set of tools and techniques had to be developed in order to meet a company’s requirements for an easy to use and cost-effective solution, which can be scaled and remotely available for multiple clients. The new system had to be developed to incorporate a company’s requirements. The QR Video Manager combines features of the existing WinkBall platform, HotSpot/Advertising Overlay technology, the channel maker and Adaptive QR code management.

8) **WinkBall TV Application Player**

In the past, IGRN realised the requirement to deliver the channel content in a cross-browser video player, which could feature programme navigation within a specific channel. The company recognised the need for a more robust and complex solution. The solution is where a player can display groups of channels that belong to a single client’s application. Social media integration and interactivity were a vital part of the requirements. In addition, the player supports HotSpots/Advertisements, dynamic QR Action codes, application wide search, channel info panels and event scheduling.

9) **Adaptive QR Code System**

This system is now part of QR Video Manager. The traditional scope for use of QR codes encapsulates returning static data to a user when scanned. IGRN required a new way of being selective about which content would be returned to the user when scanning a QR code. Considerations when determining returned data: date and time, geolocation, scan count, consecutive or alternating sequence.

The company wished to add a feature which would enable changing the behavior of QR Codes dynamically.

Technological Uncertainties

IGRN's competent professionals were uncertain about how previously developed components would be integrated together into the QR Video Manager and what combination of existing techniques, processes, software or new systems would need to be developed to ensure that the final solution would meet the requirements set.

A key challenge the developers faced was how to create an interface supporting complex management of large numbers of entities, each with their own set of complex graphical and logical functions within the new QR Video Manager.

WinkBall's developers were uncertain about how to implement a new application layer on top of the existing solution. The new player had to support existing media assets within a new system. Also support for multiple skins had to be taken into consideration.

Furthermore, as this technological solution would be based on untried methods, there was an underlying risk of failure due to system uncertainty.

The uncertainties included, but were not limited to:

10) **QR Video Management System**

Even after extensive research into existing interface patterns, there were no obvious candidates offering obvious granularity and flexibility. It was clear there was nothing on the market that could be used for our purpose. The main obstacles were the cost and integration difficulties. We had to deliver a solution that would support our existing clients end enable delivery of our content in a new abstraction layer using multiple user interfaces and branding.

Further research into the matter has concluded the following requirements:

- A management of application within various skins for multiple clients
  - A management of channels and groups of channels within the application
  - Multiplatform support for application deployments using particular skin settings
  - Subtitling and translation with ability to edit and correct AI generated files in the QR Video Manager
  - Preview facility to test and adjust playback arrangements
  - Ability to add dynamic action QR codes to a channel, a programme or a HotSpot
  - Add metadata driven dynamic redirects to a QR code so the destination URLs can be changed according to the number of preset parameters
  - QR labelling and printing, including batch processing for whole channels
  - Ability to style QR codes with clients' branding and colour schemes.
  - Banner management and creation of interactive panels, e.g. feedback, support forms, questionaries etc.

11) **WinkBall TV Application Player**

IGRN's developers were uncertain how to add new features to the existing WinkBall Channel Player so it could support new requirements and be backward compatible with the existing channel delivery

system and new QR Video Manager. Further into research it has appeared that a few prototypes have to be built. The multiple skin support and portability have represented a huge challenge.

We required a unique approach to the problem of application data loading, initialisation and network bandwidth. Developers were not sure where we could achieve the same performance across various delivery platforms.

12) **Adaptive QR Code System**

IGRN's Development Team were uncertain how to ensure the already implemented HotSpot feature could be adapted for QR codes and still remain highly interactive and not obtrusive. The developers were not certain which data to include in the model and how to manage and layout content.

Other concerns were around integration of QR Codes into the new application model with groups of channels and programmes. It wasn't clear when and how to display the codes and what priorities to give at different levels of abstraction. There was a risk of losing potential users if the QR codes became close to another form of banner advertisement with performance impact on the video playback.

Work Done

IGRN undertook an iterative agile software development approach to try and realise its objectives. Considerable effort was made to support existing clients, branding and back catalogue. The developers had to establish special practices allowing a core architecture to keep pace with the UI experimentation. Issues of maintaining backwards compatibility for existing customer configurations, combined with the requirement of integrating new approaches to UI design, led to the development of new working practices across the application design and implementation processes.

QR Video Management System

We already had a basic channel management system and simple QR creation module. The challenge was to introduce application abstraction layer with additional system requirements stated above.

Despite considerable investment into the existing channel manager the decision was taken to work on a new distributed solution in parallel to the existing one. The risk of breaking current functionality was huge.

It was decided to experiment with differing implementations, each one requiring a minimal viable design and develop a unique approach of tabularizing the core functionality. UI wizards were implemented to guide users through what were complex steps of configuration when creating and assigning the QR codes within our system.

To cope with the requirements of developing a system of this scale and with a team the size we had during the COVID pandemic, the team established a methodology of modular component reuse, whereby we could upscale functions and processes used for individual items and reuse them as batch operations, enabled in the UI. Developers had to overcome potential limitations of component efficiency with the benefits of reuse. Overall, the approach did improve application development times and reliability.

Much attention was given to the central data model to ensure its implementation returned maximum flexibility with minimal need for maintenance.

We researched, built, then extended a mechanism whereby each code was encoded with a URL containing a unique id.

When scanned, this URL would interrogate our system which would then determine from a sophisticated set of rules, the correct content to return for that code. It wasn't clear whether the mechanism would be flexible enough to cope with the numerous configurations and various QRCode types.

Ultimately testing proved successful and the codes were ‘adaptive’ for all types of code.

Increasing use of the HotSpot system developed for overlaying QR codes on playing videos lead to the necessity for a new approach.

The requirements were such that the system had to support any number of overlay requests, at varying positional locations on the playing media and capture and record user responses for marketing purposes. This led to the realisation that we could facilitate the user traversing their own journey through the structured content.

The developers challenge was to integrate all these features into a new interactive media response system. A unique implementation - not tried before.

The new engine met the requirements of the design team by facilitating tracking of users and selection of content based on a conditional set of criteria.

The implementation was flexible enough to support creation of a video/QR code-based detective game. That project is ongoing.

WinkBall TV Application Player

The team realised that the current implementation of the WinkBall player had its short comings due to the fact that the current architecture was not flexible enough for new features to be added.

We spoke with potential users to define a minimum set of requirements that would be flexible enough to cover all envisaged use cases. We realized we needed a proprietary solution as it needed tight coupling to both the QR Video manager and the player.

The decision was taken to build new player prototypes for experimentation with different layouts and driven by different data models.

The team took an iterative approach to build a modular version of the players with all the extra features as per the requirements specification. Each player version is also backward compatible with our delivery platform for channels and programmes.

The type of players built are as follows:

10. A single programme player
11. A single channel player
12. Multi-channel player
13. Application player with support for a featured channel and arbitrary groups of channels within the player.

The developers have ensured support for new data architecture which is governed by the QR Video Manager. This was the key challenge as new the QR Video Manager was rapidly evolving.

The player also supports new QR code delivery and can also have a different look and feel depending on the client requirements.

One of the requirements for the Application player was to integrate a cross channel programmes search into the player. This task is achieved by loading a new data model on the client side together with video playlist and creating a searchable text index. The index then is stored in memory and is part of our custom player implementation. Such an approach has allowed us to deliver an almost instantaneous, as you type, search experience to the end user.

QR action links also made it possible to use the Application player as a fully-fledged marketplace that can be connected to any e-commerce platform.

Adaptive QR Code System

While building the QR Video Management System the team had to port an adaptive QR code system, previously developed as a stand-alone module, into a new environment. The old and new system had to coexist during the transition.
The developers also realised that extra features had to be added to make the system more attractive and flexible to the end user.

These included a QR code customisation wizard that allows customised styling of the QR background and foreground, branding overlay that can include a client's logo or any other image.

The team had also extended types of QR Code supported to include a document upload, an audio upload and a video upload.

The action links were extracted into separate category along HotSpots and Banners.

To support new features a set of new UI interfaces had to be developed and tested in conjunction with our existing clients.

For truly dynamic QR codes, we had to go one step further and allow automatic reassignment based on some arbitrary information such as time of the day, date, or the number of times referenced.

Some of these codes would be displayed in digital media such as videos but others would be displayed on physical objects such as newspapers, leaflets, etc. Therefore, the reader or consumer of the QR code could be in a variety of different geographical locations. We were to factor geolocation into the algorithm for programme selection (URL target) for a given code. We could then display information in response to reading a QR code, specific to a users' location.

We developed and modelled the concept of a QR code "Redirect". By assigning one or more Redirects to a QR code, and assigning trigger thresholds to each, it was now possible to have a fully automated system where the location e.g programme a particular QR code referenced, was determined entirely automatically and based on a set of predefined rules.

Given the urgency of the requirement and the scope of our resources, we required a solution built on our existing implementation.

Summary

During this qualified period, IGRN has built on top of its WinkBall platform by extending and improving existing products and by adding a bespoke QR Video Manager and Application Video Player.

This was a continuous process of implementing, developing and refactoring aspects of the platform to eliminate any bottlenecks that reduce performance and compatibility with new features.

The development of the WinkBall platform is still on-going with several technological milestones yet to be delivered.

Research undertaken by IGRN established that there were no existing products capable of fulfilling the business requirements necessary to achieve seamless WinkBall platform evolution. In particular, research and development were concentrated around QR Video Manager and Application Video Player.

Therefore, IGRN was obliged to undertake the work itself and come up with novel and innovative ways to solve the arising issues at considerable risk. However, the dedication and skill of the management and IT specialists have developed and delivered a ground-breaking platform that continues to push the boundaries forward in this field.