Institution: The University of Nottingham

Unit of Assessment: Computer Science and Informatics (11)

Title of case study: Broadcasting thrill for television, advertising and public engagement

1. Summary of the impact

Research at the Mixed Reality Laboratory (MRL) into using wearable biosensors to capture and broadcast the experience of riding rollercoasters has driven innovation in how to create, film and broadcast thrilling experiences that has impacted on television, advertising and public engagement. The underlying research received three best paper awards at the ACM's CHI conference and featured as the cover article of Communications of the ACM. Through consultancies for the BBC, Lionsgate, Merlin and TBWA, we have used our techniques and platforms to create numerous television features and online films. Collaborations with TV producer RDF, supported by the Technology Strategy Board, have produced pilots of new television shows. The resulting television broadcasts, enhanced with participation at science festivals, have also engaged many millions of members of the public worldwide with the research into biosensing.

2. Underpinning research

In 2006, the MRL began collaborating with the artist Brendan Walker, founder of the creative company Aerial, to explore how biosensing technologies can enhance thrilling experiences across the entertainment sector. Over the subsequent seven years, we explored the use of wearable and networked biosensors that capture heart rate, galvanic skin response, and facial muscle movements, alongside acceleration data and video, to enable new forms of entertainment.

There have been two related technical thrusts to this work. The first has been to establish the underpinning technologies for capturing various forms of biodata from participants on rollercoasters and other thrilling experiences and transmitting it to spectators so that they can share in the experience. The second has involved also using this captured biodata to create human-in-the-loop interactive rides in which a robotic ride platform monitors and adapts to its riders' physiological responses. This work generated the following outputs that have led to the impact reported below.

- An initial paper at the ACM's flagship CHI conference – the leading international venue for research in human-computer interaction – in 2008 first introduced the core idea of broadcasting riders' biodata to spectators and reported an exploratory study involving the deploying of three amusement rides at the Science Museum [1].
- Our best paper winner (awarded to the top 1% of all submissions) at CHI 2009 proposed a conceptual framework for analysing and designing entertainment experiences including amusement rides in terms of various kinds of interleaved trajectory [2].
- A paper at CHI 2011, also a best paper winner, extended our explorations of sharing ride experiences to consider the development of novel souvenir systems [3].
- A further CHI 2011 paper explored the use of biosensing to create a series of prototype breath-controlled rides including a bucking bronco ride that responded to riders' breathing to create a human-in-the-loop robotic ride system [4].
- A third CHI best paper winner, this time at CHI 2012, explored the deliberate use of discomfort in the design of entertaining, enlightening and socially bonding experiences, focusing on biosensing driven rides as an example and including a discussion of involving spectators in voyeuristic experiences [5]. A shortened version of this paper featured as the cover article of Communications of the ACM in September 2013 [6].

The key researchers were: Benford (Prof), Walker (transitioned from Research Associate to Senior Research Fellow over this period), Schnädelbach (Senior Research Fellow), Egglestone (Research Fellow) and Marshall (PhD student to Leverhulme Fellow). They are all currently still working at the

MRL. Since 2009, Walker has been employed as a Research Fellow at Nottingham while also continuing to run Aerial and consulting for the television, entertainment and theme park industries. This has provided a direct route to realising the impact of this research as we discuss below.

3. References to the research

Citations as reported by Google Scholar on 21st September 2013

Papers marked * were awarded best papers at the CHI conference (top 1% of all submissions)

[1] **Schnädelbach, S., Egglestone, S.,** Reeves, S., **Benford, S., Walker, B.,** Wright, M., Performing thrill: designing telemetry systems and spectator interfaces for amusement rides, Proceeding of the SIGCHI conference on Human Factors in Computing Systems (CHI '08), 1167-1176, ACM, 2008, http://doi.acm.org/10.1145/1357054.1357238 (32 citations).

*[2] **Benford, S.**, Giannachi, G., Koleva, B., Rodden, T., From interaction to trajectories: designing coherent journeys through user experiences, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '09), 709-718, ACM, 2009, http://doi.acm.org/10.1145/1518701.1518812 (62 citations).

*[3] Durrant, A., Rowland, D., Kirk, D., **Benford, S.,** Fischer, J., **McAuley, D**., Automics: souvenir generating photoware for theme parks, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11), 1767-1776, ACM, 2011, http://doi.acm.org/10.1145/1978942.1979199 (16 citations).

[4] **Marshall, J.,** Rowland, D., **Egglestone, S., Benford, S., Walker, B**., **McAuley, D**., Breath control of amusement rides, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '11), 73-82, ACM, 2011, http://doi.acm.org/10.1145/1978942.1978955 (14 citations).

*[5] **Benford, S.,** Greenhalgh, C., Giannachi, G., **Walker, B., Marshall, J.,** Rodden, T., Uncomfortable interactions, Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12), 2005-2014, ACM, 2012, http://doi.acm.org/10.1145/2208276.2208347 (11 citations).

[6] **Benford, S.,** Greenhalgh, C., Giannachi, G., **Walker, B., Marshall, J.,** Rodden, T., 2013. Uncomfortable user experience. Communications of the ACM, 56(9), 66-73, ACM, 2013, http://doi.acm.org/10.1145/2500889.

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- The Horizon Digital Economy Research Centre (RCUK, 2009-2014, £11.5M, EP/G065802/1)
- Two Arts Council of England grants (2009, £4,997) and (2010, £9,941)

4. Details of the impact

This research has impacted three beneficiaries:

1. **Television** – broadcasters and production companies have employed our technologies and expertise to produce features for existing TV shows and to innovative new TV formats.
2. **Advertising** – agencies and their clients have engaged us to help deliver unusual marketing campaigns for visitor attractions, amusement rides, horror films and even cars.
3. **The Public** – a series of live exhibitions of biosensing controlled rides at Science centres and festivals have directly engaged thousands of people with our research, while the above-mentioned television broadcasts have reached many millions more worldwide.

1. Television

Our research into broadcasting riders' physiological responses to spectators reported in [1], along with our proposals for documenting rider's experiences reported in [2] and [3], have led television companies to experiment with incorporating biodata into TV programs. Their motivations have been to provide close-up and unusual views of intense experiences such as riding rollercoasters, but also to help support a common narrative of the 'scientific' investigation of such experiences.

Each of the TV features, in the edited selection below, applied the techniques for broadcasting close up views of riders' experiences reported in [1,2,3,5,6] to professional television production:

- An extended feature in the Discovery Networks International-commissioned programme Engineering Thrills produced by Waddell Media and first broadcast worldwide in October 2008 [http://youtu.be/6LOQtclGnYY].
- An article that ran across two episodes of the BBC 1 Blue Peter flagship children's show in March 2009 in which presenters tested a rollercoaster by riding it while wearing biosensors so that their physiological responses could be shown and discussed back in the studio [http://youtu.be/FM8GET0f6rU].
- An article on The One Show in which presenter Christopher Biggins experienced a vertical drop rollercoaster that aired in October 2009 [http://youtu.be/fx6y4DMo8No].
- A feature article on the Discovery Canada popular science magazine show Daily Planet, that aired in November 2011 [http://youtu.be/RBZmFH0roF4]
- A feature article on the BBC popular science programme Bang Goes The Theory that aired in August 2009 [http://youtu.be/IpBlm4pOT0Q].
- A June 2011 article on ITV Daybreak that shows a Thrill Laboratory experiment on breakfast TV presenter (broadcast and online) [http://aerial.fm/docs/update.php?id=157:33:0:1]
- The lead article on the BBC's Blue Peter in May 2013 in which the show's two presenters compared their reactions to Alton Towers' new ride, 'Smiler' [http://youtu.be/hwESXZSlJ94].

Not only did these various productions build on our published research, but also they employed our researchers as creative, technology and data analysis consultants and directly used the technologies that we have developed to capture, analyse and visualise biodata.

These productions led to further impact through an extended collaboration with the TV production company RDF [A] to explore the wider potential of biosening to underpin entire new television formats. RDF commissioned us to work on pilots for two new shows: 'Honey I'm Hot Again', a not-for-air makeover pilot for Discovery Channel in 2010; and 'Fright Club', a not-for-air game show pilot for E4 in 2012. These led to the award of a TSB IC-Tomorrow 'Digital Innovation in TV Award' in February 2013 that included an opportunity to pitch new format ideas to Channel 4, Maverick TV, Zodiak TV, BBC News and MTV Networks. Feedback from the TSB stated that all industry members wish to talk further about incorporating our research into industry projects [B].

2. Advertising

The same research has also been exploited by marketing companies to create innovative campaigns for thrilling products. Drawing on the approach reported in [1,2,5,6], Merlin Entertainments Group [C], the world's second largest provider of visitor attractions, used our technology and know-how to market two new attractions, a 'horror maze' themed around the film Saw VII at Thorpe Park, and a new interactive ride at The London Dungeon. Summit Entertainment (part of the global film production and distribution company Lionsgate) engaged us to help produce a promotional trailer for their horror movie Sinister in which audience members' 'fear factors' were measured as they watched a pre-screening of the film. These led us to being engaged as consultants by the global advertising agency TBWA to support their "Built to Thrill" brand activation campaign for the NISSAN Juke car which involved us conducting a series of thrill experiments to

measure peoples' physiological responses to various driving-related thrilling experiences. The results were incorporated into four short films [http://youtu.be/MS3qIvA_vNQ] that appeared on the campaign website that reached 164,000 consumers [D].

3. The Public

Working with rides and other thrill experiences has also captured the public's imagination and proved attractive to science communicators. Our research has therefore also delivered significant impact through public impact, engaging millions of people with the potential use emerging biosensing technologies to help us understand the physiological and emotional aspects of thrill.

Festivals

Building on the approach described in [1,5,6] and the specific breath-sensing technologies reported in [4] we have been commissioned by science communicators to engage thousands of people with a hands-on experience of our research at festivals and exhibitions, including EPSRC's Pioneers exhibition in 2008 [http://youtu.be/Iz7ZM7EnGVQ] where we exhibited the bucking bronco ride from [4], The 2011 Cheltenham Science Festival for which we created PerPing, a breath-controlled 'tennis' game [http://www.thrilllaboratory.com/experience/PerPing.html]; and the Mayhem Horror Film Festival in 2009, 2010 and 2011, where we conducted 'fear experiments' on audience members who watched classic horror films [http://aerial.fm/docs/projects.php?id=136:0:0:0]. The Pioneers exhibit was subsequently nominated for the International Digital Arts award at Future Everything, the UK's leading annual festival of digital arts.

Television

The television features described above have many millions of viewers. For example, BBC's One Show typically attracts over 5 million viewers and Bang Goes the Theory over 3 million viewers. Waddell media, producers of the early Discovery Channel programme on roller coasters, estimate that it will have received over 5 billion views as a result of regular repeated broadcasts across multiple international regions [E]. Radio coverage has included BBC World Service [http://bbc.in/NfMMbe] and You and Yours.

Press

The various activities described above have generated extensive press coverage, impacting on further millions. This includes coverage in the New York Times (February 2008), Daily Mirror (October 2008) [http://mirr.im/18PFaKj], Observer Magazine (May 2009), the BBC's Focus science magazine (August 2009) [http://sciencefocus.com/feature/thrill-engineers], Guardian Science Weekly (November 2010), the Independent (August 2011), New Scientist (May 2011) [http://www.newscientist.com/blogs/onepercent/2011/05/amusement-park-rides-that-know.html], and the London Evening Standard (June 2012). Our research featured as the cover article of The Times' Eureka science supplement in January 2010 [http://www.aerial.fm/docs/content/Eureka.pdf] and as the cover article of the September 2013 edition of Communications of the ACM [6], which reaches 100,000 computing industry professionals worldwide.

5. Sources to corroborate the impact

[A] Letter with corroborating evidence from RDF Television.

[B] Feedback from TSB with corroborating evidence, 8th February 2013.

[C] Letter with corroborating evidence from Merlin Entertainments Group.

[D] Letter with corroborating evidence from TBWA, 26th July 2013.

[E] Letter from Waddell Media with corroborating evidence, 2th August 2013.