# The Gas Mask: A Probe for Exploring Fearsome Interactions

**Joe Marshall**[1]
jqm@cs.nott.ac.uk

**Brendan Walker**[1,2]
info@aerial.fm

**Steve Benford**[1]
sdb@cs.nott.ac.uk

**George Tomlinson**[2]
yerrowdog@yahoo.co.uk

**Stefan Rennick Egglestone**[1],
sre@cs.nott.ac.uk

**Stuart Reeves**[1]
stuart@tropic.org.uk

**Patrick Brundell**[1]
prb@cs.nott.ac.uk

**Paul Tennent**[1]
pxt@cs.nott.ac.uk

**Jo Cranwell**[1]
psxjc3@nottingham.ac.uk

**Paul Harter**[3]
paul@cleverplugs.com

**Jo Longhurst**[4]
jo@jolonghurst.com

[1]Horizon Digital Economy Research and the Mixed Reality Lab University of Nottingham, UK

[2]Aerial, London, UK

[3]Clever Plugs Ltd, London, UK

[4]European Centre for Photographic Research, University of Wales


*CHI 2011*, May 7–12, 2011, Vancouver, BC, Canada.
ACM 978-1-4503-0268-5/11/05.

## Abstract
We introduce an interface for horror-themed entertainment experiences based on integrating breath sensors and WiFi into gas masks. Beyond enabling the practical breath control of entertainment systems, our design aims to heighten the intensity of the experience by amplifying the user's awareness of their breathing, as well as their feelings of isolation, claustrophobia and fear. More generally, this interface is intended to act as a technology probe for exploring an emerging research agenda around fearsome interactions. We describe the deployment of our gas masks in two events: as a control mechanism for an interactive ride, and to enhance a theme park horror maze. We identify six broad dimensions – cultural, visceral, control, social, performance and engineering – that frame an agenda for future research into fearsome interactions.

## Keywords
Gas mask, breathing, fear, sensors, entertainment, visceral, cultural, performance, spectating, control

## ACM Classification Keywords
H.5.2 [User Interfaces]:*Input devices and strategies*

## General Terms
Design

## Introduction

A range of popular entertainment demonstrates a widespread and growing public appetite for extreme, visceral, and horrifying experiences. From traditional stories, ghost trains and haunted houses, to today's horror films, computer games and thrill rides, the entertainment industry appears to be constantly raising the stakes in terms of the lengths it will go to in order to scare consumers. As entertainment becomes increasingly extreme and yet also interactive, HCI must surely consider how interaction can be deliberately designed to be suitably fearsome.

We present a gas mask interface that has been designed as a technology probe to help us explore the nature of fearsome interactions, balancing the goals of collecting information about the use of a technology in real-world settings, inspiring users and designers, and field-testing the technology as described by [12]. Our interface integrates breath sensors into a rubber mask along with WiFi that enables breathing data to be wirelessly transmitted; there is also the option of incorporating a wireless microphone. We describe two preliminary probing experiences: *Breathless*, an interactive ride which explores notions of control and submission to the control of others; and a live replay event extending the experience of the *Saw Alive* horror maze at Thorpe Park, UK. Based on preliminary feedback from these experiences, we then articulate a wider agenda for research into fearsome interfaces.

## The Gas Mask interface

The idea of the gas mask interface emerged from a long term project to develop interactive entertainments using biological sensing, which led to the idea of exploring the aesthetics of respiration monitoring as a form of engaging spectacle and gaming interaction. During the development of the mask interface, we carried out an initial pilot study using a crude chest strap breathing monitor to control a bucking bronco ride. This revealed that breath control was feasible, fun and challenging, and also showed how riders would become more aware of their own breathing as they struggled to control both the machine and their own bodily response [15]. The fully developed interface we describe here 'ups the ante' with an interface that further heightens these sensations. The gas mask is designed to be used as part of intense experiences that challenge participants to engage with and confront fear – an essential ingredient in thrill rides, horror films and similar experiences. The use of a gas mask appealed due to its striking aesthetic, strong cultural resonances (from wartime horrors to fetish wear), distinctive visceral physicality (affecting sight, touch and smell), and practical ruggedness – issues that we revisit in greater depth later on.

We begin with a brief introduction to the device itself. The core of our device is the gas mask, a British Army *S10* Gas Mask and Filter. These standard pieces of equipment are used by military personnel (and are also popular amongst fetish-wear enthusiasts). The Filter (on the right in Figure 1), is a detachable part, which cleans air coming into the mask. In our system, we customise this filter to create a Respiration Monitor, which contains two gas flow sensors, batteries, and an Arduino microprocessor board, with a WIFI extension shield attached to it. For safety reasons, we have modified the front of the gas mask so that air can flow into and out of the front of the mask without obstruction. This means that only a small percentage of the air breathed by the wearer goes through our

Respiration Monitor. For our purposes we assume that the percentage of sensed air volume flow rate to actual air volume flow rate is constant, meaning that the total air flow can be assumed to be a constant multiple of the flow measured by the flow sensors. We use two flow sensors, as these are directional, to sense both inhalation and exhalation rates.

The microprocessor records readings from both the flow sensors at 20Hz, and transmits them on a WIFI network using local broadcast. This allows us to obtain low latency inhalation and exhalation rates, while the wearer can move around freely. These messages can be received and processed by any other device connected to the WIFI network. In the events described later in the paper, we used custom server side software for each experience. As well as the breathing sensor, we can also fit a specialist gas mask microphone to the other side of the mask, which allows for audio to be transmitted as well as breathing data (using an off the shelf radio microphone transmitter).


**Figure 1.** Gas Mask and Respiration Monitor

## Probing fearsome experiences

We built 5 Respiration Monitors in total and used them to create 2 different public experiences that probed different aspects of the nature of fearsome interactions. We recorded breathing and video data and interviewed participants immediately afterwards.

*Breathless: An Interactive Ride*

Breathless was an interactive ride that used Gas Masks with Respiration Monitors to control a large powered swing. To make this work, a selected Respiration Monitor was used to send breathing data to the ride control computer, which in turn actuated the swing, pulling it backwards when the rider inhaled and forwards on exhalation, in direct proportion to the subject's lung capacity calculated in real time. Due to the natural pendulum nature of a swing, this meant that to make the swing climb higher, the subject needed to breath in harmony with the swing's resonant frequency. The swing length was chosen to resonate at a comfortable breathing rate of 12 breaths per minute. The ride was developed so that it could be controlled by any of our 5 Respiration Monitors, which enabled control to be switched from one subject to another, for example between riders and spectators.

**Figure 2.** Appropriated image of *The Swing* by Fragonard

The overall ride experience was inspired by the painting '*The Swing*', by Jean-Honore Fragonard [7]. The painting reportedly [11] depicts an erotic scene involving three people: a woman riding the swing, a voyeur in the bushes watching the woman's exposed legs, and a bishop controlling the swing via a pull rope. Figure 2 shows an appropriated image of *The Swing* (with additional gas masks), which was used in the promotional material for the *Breathless* event.

In *Breathless*, participants assume all three roles in turn: *Voyeur*, *Rider*, and *Controller* (Figure 3). When a participant arrives, they join a queue and are fitted with a Gas Mask and Respiration Monitor when they reach the front. This participant is then taken by a performer to a location where they become the *Voyeur* and watch a floodlit *Rider* swinging in front of them. Once the ride stops, the *Rider* dismounts and is taken to a seat next to the swing to become the *Controller*. Our *Voyeur* is then led by a performer onto the swing to become the *Rider*. At this point the floodlight is extinguished and the *Controller* is spotlit from above. The *Controller* - now experienced in breath control - initially controls the swing, leaving the *Rider* completely at their whim (meanwhile, the next person in the queue is fitted with mask and monitor to become the next *Voyeur*). After a while, the spotlight on the chair is extinguished, and a floodlight illuminates the swing. At this point, control of the ride passes over to the *Rider* (the *Controller* is then led away by a performer, their mask is removed, and they exit the experience). If the *Rider* is not already breathing in sync with the swing, this leads to an interesting moment as the motor jerks across to follow a different breathing rhythm. After roughly 2 minutes, the ride stops, the *Rider* is moved to assume the role of the *Controller* and our new *Voyeur* becomes the next *Rider*.

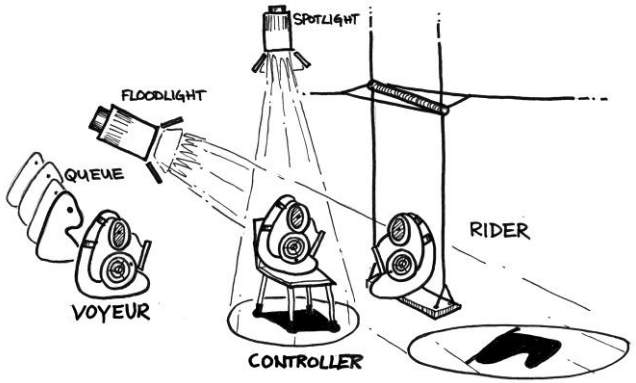


**Figure 3.** Roles of participants in Breathless

**Figure 4.** Rider in *Breathless* swing (controller seated at back)

We interviewed riders after they had taken part in Breathless, to explore their impressions of the ride. A recurring element in people's response was a feeling of isolation due to the enclosed nature of the mask - "*you become in a kind of bubble, by being in the gas mask and so you become completely alone in that space*". The reduced vision and the focus on breathing encouraged by the gas masks also increased the intensity and scariness of Breathless - "*it's just that breathing, hearing the sound of like breath going in and out you know, I find it really quite, and not being able to see, like blinkered or tunnel vision, …… scary isn't it.*". In addition, the aesthetic, of a darkened area, with multiple gas masked people and a large wooden swing added to the fear that people felt, even before they took part in the ride - "*it was quite nerve wracking actually… just the weird sort of spectacle, of someone swinging in the darkness, with gas masks, is enough to make anyone a bit .... It was like, really, Nazi like … some weird, like holocaust association for me.*"

*Gas Masks at Saw Alive*

The *Saw Alive* maze at Thorpe Park, UK, is essentially a modern day version of a fairground house of horrors. It features a set of extremely dark rooms, each themed after a scene from the film *Saw* [21]. These rooms are filled with dilapidated industrial equipment, torture equipment (manacles etc.), mutilated bodies, and populated with live actors who chase, scream and pretend to attack participants. The maze is lit by flashing strobes, large electrical sparks, and filled with smoke effects. As well as the noise made by the industrial equipment, an extremely loud soundtrack of death metal music plays constantly.

We took the Gas Masks and Respiration Monitors, and put them on participants in this (already very intense) situation, in order to explore how the masks would affect people's fear. We created a performance to frame our experiments where participants were invited to "become Agents to help investigate the effects of horror and fear on the human respiratory system". We recruited 5 groups of 4 participants from the existing queue line and brought them into a control room behind the maze. Each group of four was split into two pairs. One pair was fitted with gas masks. They were also given small infrared torches, fitted with an infrared camera, which allowed them to film whilst going through the maze, while not being able to see any more than a normal participant would (Figure 5). While this first pair was sent into the maze, the second pair sat in front of a monitor screen alongside a member of our event team (Figure 6). On this screen, they could see breathing traces from the first pair alongside video from their cameras. They were also able to hear audio from the gas masks. The team member talked them through the breathing data being shown on the screen.

Once the first pair completed the maze, the roles switched over, with the first pair watching, and the second pair going into the maze.

**Figure 5**. Gas mask and infrared torch camera

**Figure 6.** Watching transmitted video and breathing data

This created an interesting dynamic; the second pair, who had already heard the screams of the first pair, had an increased level of fear about the maze. The following transcript from post-experience interviews illustrates one pair of people who were very scared after watching, but talked each other into taking part:
P1:"*I felt really shaky after we watched it…*
*Question: "because then you went in yourselves?"*
*P1:"* yeah … *it made me feel really weird"*
P2: "*it's a bit you feel like oh no I don't want to go now ... but by the end you changed your mind"*
P2: "*literally did not want to go in at all"*
*P1: but then you were like really don't want to do it I was like come on we're doing it"*

In general, the mask experience, made for a far more scary experience than the normal maze –"*literally terrifying, I can't believe how scared I was ... I've never been scared like that by anything before … I went in the Saw maze in May and erm it was rubbish we were all hyped up … and afterwards like we were all laughing…. then this happens and [laughs] it's just amazing my friend's not going to believe it it was so scary it was really scary*". In some ways, people appeared to find it scarier simply because having the masks and knowing their data was being transmitted took their mind off the nature of the attraction - "*in one of these tour round the haunted house things it sort of feels like the purpose is to be scared but with like cameras and things we got sort of a different purpose so you're not thinking their supposed to scare me it made it much more intense much more scary*". The smoke pumped into the maze made the masks fog up somewhat, which aided their claustrophobic effect - "*it's really misty and like I can't see anything and my main thought was just get out get me out of here just get to the end get to the end*"

## Six dimensions of fearsome interactions

Cockton [6] suggests that HCI should seek to create value, where the definition of 'value' is a subjective quantity, based on the particular use and users of a system. When designing systems to support horrifying, scary and disturbing experiences, we are working with very different values to those of most HCI designers. Reflecting on our experiences with the gas masks, we now identify six key dimensions of designing fearsome interactions, intended to serve as a broad outline agenda for further research in this area.

*The cultural dimension*

As Blanchard et al. [4] describe, emotions and culture are particularly intertwined. When creating interfaces to support intense emotions such as fear, it is therefore important to consider how these interfaces are situated within "*society, individual experience, culture, and history*" [20]. Our gas masks clearly have a very striking and unusual aesthetic with strong cultural associations. For many, gas masks evoke images or memories of warfare, for example trench warfare from the First World War or air raids from the Second World War. More recently, gas masks have come to be associated with law enforcement, for example through television coverage of riot control police in public order situations. It is therefore not surprising that gas masks already feature in computer games and films relating to war and also science fiction & horror (e.g. the computer games Resident Evil [16] and Call of Duty [13]). Gas masks may also resonate with the use of respirators in medical procedures or masks to prevent the spread of airborne disease, evoking fears of painful operations or illness. They are also associated with sexual behaviour as part of sexual practices surrounding breathplay and erotic asphyxiation. Moreover, bondage wear is now increasingly fashionable – for example London's *Torture Garden* (*TG*) fetish and body modification nightclub has moved over the last 20 years from being a semi-legal club, regularly shut down by the police, to become a well established entertainment and fetish clothing brand. Interestingly, other researchers have noted HCI's 'tendency to desexualise technology' and have sought to raise an agenda for researching 'sexual interactions' [5]. It is therefore important to recognise that gas masks may suggest various fearsome and/or sexual associations and possibly heighten both kinds of arousal. Future research should explore how the aesthetic form of a device might, through specific cultural associations for particular users, invoke particular fears.

*The visceral dimension*

There is a striking physicality to donning a gas mask which may amplify the fearsome nature of horror experiences in several more direct ways. Gas masks are often uncomfortable to wear, especially for the uninitiated, with a close physical fit and overpowering rubbery smell. They soon become hot, especially when people exert themselves, and may begin to fill with sweat, which drips down the face in a disturbing way. Highly restricted visibility can be disorientating, especially as the eye-holes have a tendency to fog. The seemingly enclosed nature of the mask may also create a fear in participants that the experience might cut off their breathing in some way (although our masks are designed not to restrict breathing as noted earlier). The result for many is an unusual and somewhat uncomfortable physical sensation, while others may experience something closer to claustrophobia. In this way, the interface may encourage participants to confront a specific personal fear, as do other

entertainment experiences such as roller-coasters which routinely exploit fears of heights, speed and crashing into obstacles, the latter through with 'head chopper effects' in which it appears that the rider is going to hit part of the ride superstructure until the very last moment. A few previous HCI projects have explored visceral interaction, for example by using rotting raw meat as a tangible interface [14] or studying how to create fear using audio sound effects in games [8]. The wider challenge here is to understand how to create visceral interfaces that deliberately and uncomfortably impinge on the user's consciousness rather than seamlessly fading into the background as is the goal for many more mainstream interfaces.

*The control dimension*

An important aspect of fearsome experiences such as thrill rides or perhaps even watching a horror film is that of giving up control; committing to a scary and unknown experience and not being able to back out, either physically or socially. Previous work has argued that breath control of rides is interesting precisely because riders cannot fully control their own breathing and so are often brought to a point of surrendering control to the machine [15]. Our gas mask interface amplifies this because the user cannot disengage from it; the sensor is strapped to their face, emphasising the message that the machine will sense and respond to their every breathing action. This also extends to the use of wireless microphones, reflecting an earlier study of a personal telemetry system that transmitted audio from riders on amusement rides to nearby spectators, which noted that some riders worried about what they had said over a public channel as they lost control of themselves [19]. We also note that in *Breathless*, people are ushered through the experience by uniformed performers, with minimal conversation, which further extends the sense of loss of control. Contrary to conventional HCI wisdom which argues that users should be able to gracefully manage their engagement and disengagement with sensing systems [1, 2], the wider challenge here is to create interfaces that require them to surrender or at least fight for control.

*The social dimension*

The gas mask interface perturbs the social relationships among participants in interesting ways. Enclosing a person's face completely creates a situation in which they are made anonymous, with the mask mediating contact between the wearer and others [17]. This works in two ways, firstly on the wearer themselves, potentially making them feel isolated and possibly even dehumanised, as an experimental subject or victim. Secondly, those seeing the wearer may not see a person, but rather see an anonymous subject, hidden within an aggressive looking military gas mask. Breathless also demonstrates a social element to loss of control as discussed above by enabling one participant to control, through their breathing, the physical experience of another, playing on the fear and thrill of being controlled by, and controlling, others.

*The performance dimension*

The performance structures of both events serve to further amplify the fearsome nature of interactions. First is the idea of building anticipation by revealing some, but not all, aspects of the experience, an approach that Reeves et al. describe as 'suspenseful' interaction [18]. Thus, we ensured that participants could see some, but not all, elements of the system in advance, for example in Breathless participants could

see the swing, and see multiple people in gas masks, but were not told how things worked. They also spent some time watching the ride whilst wearing a gas mask before taking their turn. Similarly in Saw Alive, the second pair of participants saw their friends go into the maze, heard their screams and watched the (often erratic) video from their infrared cameras, but did not really know what was going on. This form of spectating, whilst not revealing the full experience, adopts a strategy of keeping the interaction somewhat ambiguous, allowing the participant to interpret the situation themselves [9], in the hope that their imagination will make them anticipate things will be worse than they actually are. Thus, we also made people wait whilst fully kitted up in the gas masks and related equipment, creating a moment of reflection [10], where people may contemplate the fear that is to come. We also carefully managed the levels of social contact between participants, shepherding them through the process, so that they did not have any significant time to speak to previous participants before taking part themselves. The challenge here is how can we create and interleave 'trajectories' through the experience [3] to maximise anticipation through appropriate pauses and to allow opportunities to spectate others' interactions.

*The engineering dimension*

Finally, while it may seem obvious, we acknowledge the significant engineering challenges involved in creating wearable sensors that are sufficiently robust to operate within ride-like environments. A military issue gas mask is designed to stay on and remain sealed to the face during fast moving military operations. As such, it provides a very practical and stable platform on which to mount technology, even when people are taking part in experiences requiring them to move around quickly. It is also very resilient to 'weather' conditions. The attachments for respirators and microphones are standardised amongst NATO nations, so it is very easy to obtain connectors and create custom attachments, and to obtain spare parts for the masks. Gas masks also link into other military equipment, such as drinking systems and helmets.

## Conclusions

Many popular entertainments involve people voluntarily undergoing fearsome experiences. In this paper, we have described a gas mask sensing interface deliberately designed to suit such experiences, and two events which have been run using the gas masks. As the masks demonstrate, creating scary experiences involves taking account of the multi-faceted nature of fear, which involves both cultural, visceral, social, and control factors. When designing fearsome interfaces, it is also key to consider the performance aspects of the experience in which the interface is situated, and to consider the robustness of the equipment, given the often extreme nature of fearsome experiences.

## Acknowledgements

This work is supported by Horizon Digital Economy Research, RCUK grant EP/G065802/1, and Arts Council England, grant 15361278.

## References

[1] Bellotti, V., Back, M., Edwards, W.K., Grinter, R.E., Henderson, A., and Lopes, C. Making sense of sensing systems: five questions for designers and researchers, Proceedings of the SIGCHI conference on Human Factors (CHI 2002), 415–422, 2002, ACM.

[2] Benford, S., Schnädelbach, H., Koleva, B., Anastasi , R., Greenhalgh C., Rodden, T., Green, J., Ghali, A., Pridmore, T., Gaver, W., Boucher, A., Walker, B., Pennington, S., Schmidt, A., Gellersen, H., Steed, A., Expected, sensed, and desired: A framework for designing sensing-based interaction, *ACM Transactions on Computer-Human Interaction*, 12(1), 3-30, 2005.

[3] Benford, S., Giannachi, G., Koleva, B., Rodden T., From Interaction to Trajectories: Designing Coherent Journeys Through User Experiences. *CHI '09*, pp. 709-718, 2009, ACM.

[4] Blanchard, E. G., Mizoguchi, R., Lajoie, S. P. Addressing the interplay of Culture and Affect in HCI: An Ontological Approach, in *13th International Conference on Human-Computer Interaction (HCII2009)*, Springer (2009)

[5] Brewer, J., Kaye, J., Williams, A., Wyche, S., Sexual Interactions: Why we should talk about sex in HCI, *extended abstracts (workshop) of CHI 2006*, Montreal, April 2006, ACM.

[6] Cockton, G. Value-Centred HCI in *NordiCHI '04: Proceedings of the third Nordic conference on Human-computer interaction*, ACM Press (2004)

[7] Fragonard, J. *The Swing*, Wallace Collection, London (1766)

[8] Garner, T., Grimshaw, M. and Abdel Nabi, D. A preliminary experiment to assess the fear value of preselected sound parameters in a survival horror game in *AM '10 Proceedings of the 5th Audio Mostly Conference*, ACM Press (2010)

[9] Gaver, W., Beaver, J., Benford, S. Ambiguity as a resource for design in *CHI '03*, ACM Press (2003)

[10] Hansen, L.K. Contemplative interaction: alternating between immersion and reflection in *CC '05 Proceedings of the 4th decennial conference on Critical computing*, ACM Press (2005)

[11] Honour, H and Fleming, J F. *The Visual Arts: A History*, 6th ed., p. 628, Pearson, 2002.

[12] Hutchinson , H., Mackay, W., Westerlund , B., Bederson, B., Druin, A., Plaisant , C., Beaudouin-Lafon, M., Conversy , S., Evans H., Hansen, H., Roussel, N., Eiderbäck, B., Technology probes: inspiring design for and with families, *CHI '03*, 18-24, April 2-3, Ft Lauderdale, Florida, ACM

[13] Infinity Ward, *Call of Duty*, Activision (2003-2010)

[14] Levisohn, A., Cochrane, J., Gromala, D., Seo,J. The Meatbook: tangible and visceral interaction in *TEI '07: Proceedings of the 1st international conference on Tangible and embedded interaction*, ACM Press (2007)

[15] Marshall, J., Rowland, D., Egglestone, S., Benford, S., Walker, B., McAuley, D., Breath Control of Amusement Rides, *CHI 2011*, Vancouver, April 2011, ACM

[16] Mikami, S. *Resident Evil*, Capcom (1996-2010)

[17] Moshenska, G. Gas masks: material culture, memory, and the senses. *Journal of the Royal Anthropological Institute*, 16 (3), Wiley and Blackwell (2010), 609 – 628.

[18] Reeves, S., Benford, S., O'Malley, C., Fraser, M. Designing the spectator experience in *CHI '05*, ACM Press (2005)

[19] Schnädelbach, H., Rennick Egglestone, S., Reeves, S., Benford, S., Walker, B., Wright, M. Performing thrill: designing telemetry systems and spectator interfaces for amusement rides in *CHI '08*, ACM Press (2008)

[20] Sengers, P. Kaye, J., Boehner, K., Fairbank, J., Gay, G., Medynskiy,Y., Wyche, S. Culturally Embedded Computing *IEEE Pervasive Computing* 3(1), IEEE (2004)

[21] Wan, J. *Saw*, Twisted Pictures (2004)