Eye-Balls: Juggling with the Virtual

Joe Marshall **Steve Benford** **Tony Pridmore**
Mixed Reality Lab, University of Nottingham, UK
{jqm,sdb,tpp}@cs.nott.ac.uk

ABSTRACT
The authors will introduce and demonstrate a novel computer vision based system for augmented performance. Unlike previous systems, which have primarily focused on 'high art' forms such as modern dance, this system is designed for use during a juggling performance. The system allows a juggler to interact with a computer through their movements, and the movements of the balls, to create audio and visual projections which respond to their performance.

This system has been designed in an iterative process involving amateur and professional performers, in order to create a system which is truly accessible. In particular, this project takes inspiration from mass market interactive entertainment and has been developed to only use commodity hardware and to be easily distributable, in order to allow it to be used within the small, self funded groups common in the circus arts community.

Keywords
Interactive art, performance, juggling, computer vision

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI):

THE SYSTEM
The Eye-Balls system uses a camera attached to a computer to detect the position of the head and arms of a juggling performer, and multiple balls they are juggling. Positions and velocities are then input into a script based display system, which creates interesting audio and visual output which may be controlled based on the movement of the performer or balls. This output is projected onto a large screen on stage with the performer, and output through speakers, in order to create an 'augmented' performance which is entirely controlled by the juggling performer. This is in contrast to most current performances, where the juggler is 'slaved' to their music and visual effects, and must perform exactly in time to them, with reduced scope for improvisation and audience interaction.

Eye-Balls is designed to use only commodity equipment: a laptop, a camera, a video projector and speakers. The laptop, camera and projector are all set-up in front of the performer, with a projection screen next to the performer. The laptop displays the video output so that the performer can see and interact with the output, rather than the output being purely accompaniment to the juggling performance.

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Output from the System
The simplest output from the system is a projected display of trails showing the patterns that the balls are moving in, as shown in Figure 1. The flexibility of our script based system means that scripts can do many more complex things from mixing multiple channels of music together, to complex systems such as the juggling space invaders game shown in Figure 3. This is interesting from a performance point of view, as it allows long and varied performances to be created, in contrast to many systems, which are based upon a single fixed augmentation of the performance.

DESIGN PROCESS
The aim of this system is to take interactive vision technology and use it within juggling performances. This is a particular challenge, as most juggling audiences have little knowledge of the art form, and less tolerance for more conceptual work. (Most similar work has been situated in dance, theatre and conceptual art eg.[1, 2]). Venues and performance groups are generally small, and self-funded. This makes it impossible to use expensive custom built equipment as other similar systems do

As a result, this system is being developed using a collaborative design process, with performer workshops, and public performances an important part of the iterative design process. Two workshops were run with local juggling groups, these were hobbyists, whose experience ranged from purely juggling for their own enjoyment, to experience of large scale public performances. We also spent some time with a professional performer, which gave us a much greater insight into the needs of a full-time performer, and was inspirational in terms of performance development.

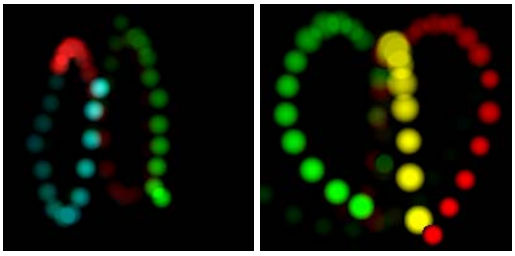

Figure 1 Display of ball patterns as trails

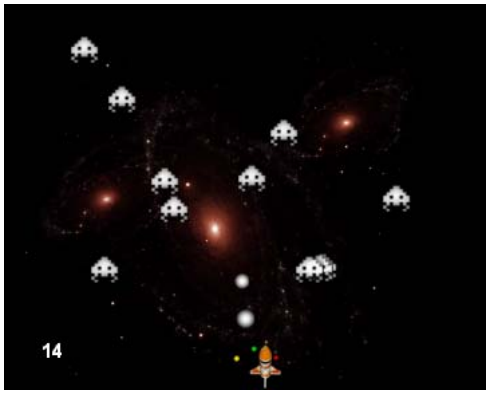

Figure 3 The juggling space invaders game

As well as this the system was recently used for a public performance at a local cabaret. This was a science fiction themed evening, and the performance was designed to fit that. It told the story of a man flying into space, meeting aliens, and his disillusionment upon returning to Earth. The performance was inspired by the song *First Man In Space*, by the band *All Seeing I*, and used loops and vocals sampled from the song as a narrative device, along with various visual elements which responded both to the juggling and to audio triggered by juggling (See Figure 2).

A major issue with this kind of system, and a focus of our future work, is how to balance the act of juggling, and the output of the system, to create an integrated performance, rather than simply juggling plus 'pretty lights'

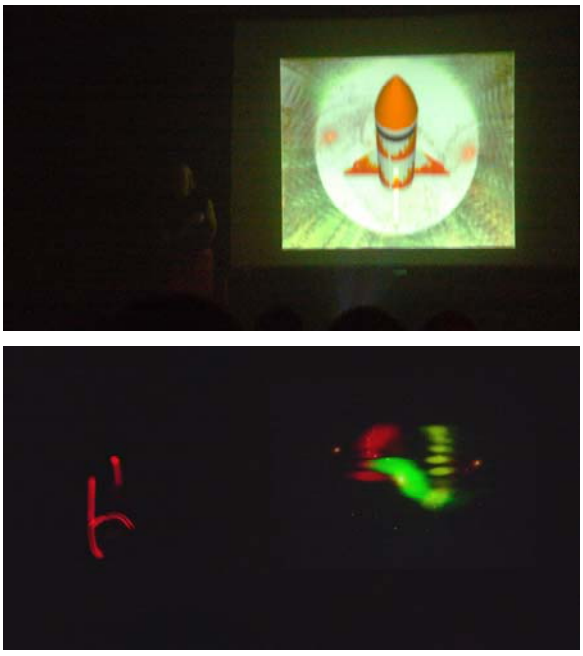

Figure 2 The system in use for live performance – the juggler is using glowing red juggling balls which can be seen on the left hand side of the second picture.

THREE PRINCIPLES INFORMING THIS WORK

The system has been designed to encourage performers to engage with the system and extend their performance vocabulary, by following three rough principles.

Design for Narrative

Typical juggling performances whilst they undoubtedly have a structure, and are performed in character, generally have limited if any narrative. Some more experimental performers have worked with narratives, for example 'Stop Breaking my Balls' by Gandini Juggling[3] uses a combination of juggling and dance to address the real life relationship of the two performers involved.

Visual accompaniments in particular allow an extra range of expression for exploring narratives. Combining these narrative elements with skill based performance creates interesting challenges, particularly in terms of how the changes in audio-visual elements are orchestrated within a performance and integrated with the juggling, without forcing the performer into a rigid set of timed actions.

Design for Play

An important part of the design process was making the system fun to play with. Games such as 'Gladiators', where jugglers attempt to make other players drop, whilst continually juggling themselves, are well established as a way for jugglers to improve their skills. For many jugglers, the act of juggling itself is seen as a game and playfulness is extremely important to the art form.

As well as working on performance scripts for the system, we created games involving hitting targets on the screen with balls, and a juggling controlled space invaders game (Figure 3). During the 2nd workshop with local jugglers, these became a particular focus for users. When developing the recent performance, an explicit focus on play was used within the design process, with many ideas coming from improvisational play with the system.

Design for Inspiration

The workshops were most interesting when, having played with the system for approximately half an hour, the jugglers started altering their performance to be informed by the system. As an example the heart shaped juggling pattern shown in Figure 1 is produced by a stilted looking set of ball throws, which only become beautiful when combined with the system.

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