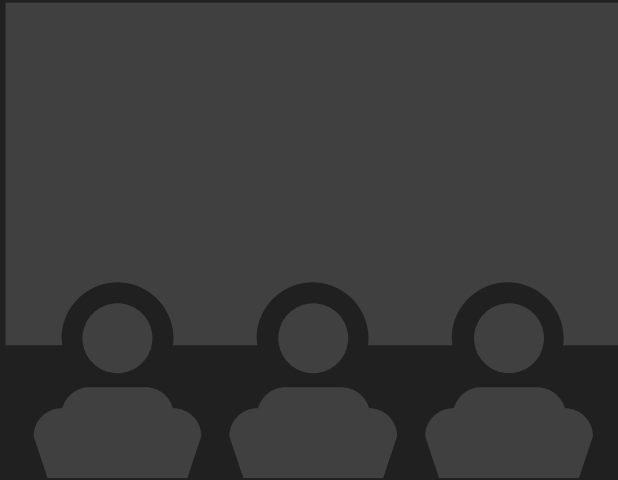# Breaking Out of the Frame

design document

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Abstract

This document discusses the design and development of *Breaking Out of the Frame*, a crowd-driven game developed for the *Generation ZX(X)* event held in Camperdown Park and the grounds of the JTC Furniture Group on 4th May 2018.

Generation ZX(X)

Generation ZX(X) was a hybrid multi-media event designed and run by Dr. Mona Bozdog as part of her PhD.

The project used games, film, an audiowalk and a choir to explore and reclaim the history of the ZX Spectrum in Dundee, and the women who built it.

Project Brief

One of the goals of *Generation ZX(X)* was to use specially-designed games to explore the history of the place and the people who worked there.

As such, 3 games were developed: *She-Town*, *Assembly*, and *Breaking Out of the Frame*.

The brief for *Breaking Out of the Frame* was for it to act as a kind of conclusion to the event; a large-scale game that could be played as a group by everyone in attendance.

Designing for a Crowd

Designing a videogame to be played by a crowd of people is a somewhat unusual task.

It requires both sensitivity to the players' game literacy (many of our audience did not come from a games background), and a set of rules or instructions that can be conveyed quickly and with a degree of clarity.

Perhaps the biggest question that arises though, is: *how will the audience/players control the game?*

Rejected Input Schemes

Microphone Input

We rejected the possibility of having the audience sing or shout to control the game because of concerns about wind noise interfering with the signal (the game was played at the top of a hill).

Mobile Phone

We decided against a mobile interface for the game for 2 reasons: **1.)** it would require players to have a phone (with data), and **2.)** players would be looking at their phone instead of interacting with each other.

Webcam Input

In the end we went with webcam input for the game as it could potentially allow everyone in the audience to participate, and it seemed to have the fewest limitations in comparison with the other methods.

Of course, the real benefit of webcam input is that it lets us design games that require the players to move and interact with each other.

Webcam Motion Detection

As our goal was to get our players to move, the main thing we needed from the webcam was some form of motion detection.

There are a variety of established motion detection algorithms, however the ones I tried all seemed to suffer from substantial lag and/or an inability to track the motion of large crowds of people.

In the end I developed a very simple background subtraction method that tests webcam frames against an image of the space that's known to be empty of people.

Webcam Motion Detection
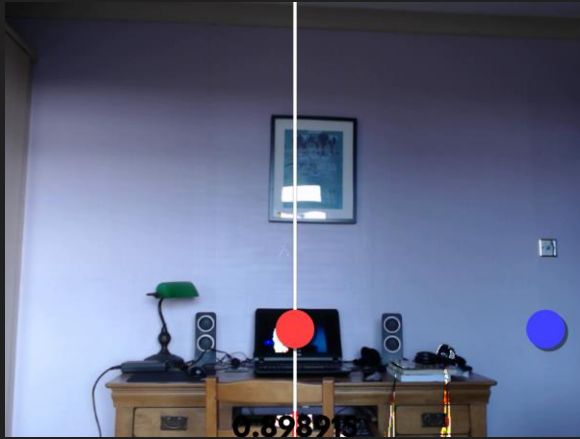
Empty Background

In setup, we acquire an image of the space without any people in it.

We will refer back to this image to determine whether anything has changed (i.e. people are moving about).

Foreground Pixels

During play, we constantly test the webcam feed against the Background image. Pixels that differ from the Background are registered as Foreground pixels.

Motion is determined by calculating the number of Foreground pixels on the left vs. the number of pixels on the right.

PROTOTYPES

PUSH AWAY

The first prototype tasked the player with clearing the screen of green and blue coloured balls by moving a central red ball which repels them.

The red ball is moved left or right depending on which side of the webcam frame has more non-background pixels.

The idea was to create a game that forced players to run back and forth in front of a screen.

PROTOTYPES

SNAKE

The second prototype used the same input mechanism as the first, only this time players control a snake, and try to eat as many 'apples' as they can within the time limit.

When played close to the webcam this encouraged a kind of swaying motion in the player, somewhat mirroring the snake's motion.

Unfortunately that doesn't translate well to a large group of people stood some distance from the webcam.
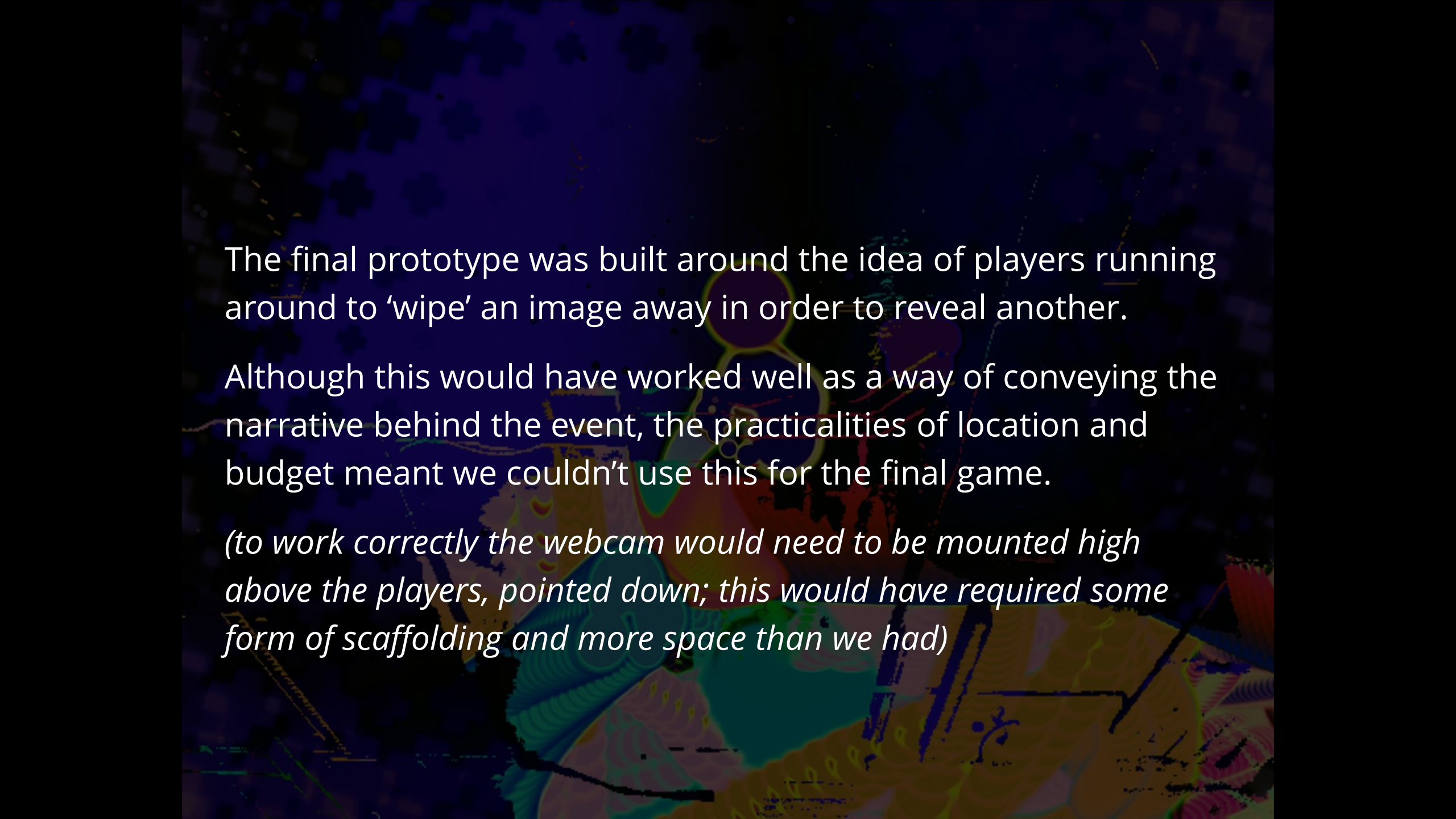
PROTOTYPES

CROWD

The third prototype used the same input method again, but this time attempted to visualise the player crowd on screen.

Arrows on the screen direct players to move to one side or the other. Whenever the arrow switches direction the number of 'players' on the correct side previously gets added to the overall score.

Given the simplicity of the motion detection method, the game does not calculate the actual number of players on each side, but makes a guess based on the number of non-background pixels.

PROTOTYPES

WIPE

The final prototype was built around the idea of players running around to 'wipe' an image away in order to reveal another.

Although this would have worked well as a way of conveying the narrative behind the event, the practicalities of location and budget meant we couldn't use this for the final game.

(to work correctly the webcam would need to be mounted high above the players, pointed down; this would have required some form of scaffolding and more space than we had)

Footage of all 4 prototypes (click to play).

FINAL DESIGN

BREAKING OUT OF THE FRAME

Breaking Out of the Frame

The final design was built around 3 elements:

- The moving-left-and-right control scheme from the first 3 prototypes.

- The physical space we played the game in; it was projected onto a window on the wall of the JTC factory.

- And the desire to convey a condensed history of the ZX Spectrum and the women who built it.

The Goal of the Game

Players control a pixelated avatar (designed for the She-Town game by **Cara Pearson**) by running left and right in front of the webcam.

Their goal is to collect falling ZX Spectrums, while avoiding any falling Commodore 64s.

Projection

As the game was to be projected onto a window on the side of the factory, we wanted to try and use the window itself as a frame.

As players collect the falling Spectrums, they reveal part of an image behind the playfield.

On collecting 3 Spectrums the full image is revealed, expanding beyond the bounds of the window (i.e. *breaking out of the frame*).

Conveying a Story

We used the mechanism of collecting 3 Spectrums to reveal an image as a way of conveying the story behind the *Generation ZX(X)* event.

This gave the game a distinct structure and pacing. Players would run back and forth for a bit, then rest while the image is revealed, and repeat.

We had 5 images in total, created for the game by **Kayleigh MacLeod**.

Gameplay footage of Breaking Out of the Frame (click to play).

Footage of the Generation ZX(X) event (click to play).

What Worked Well

The game appeared to be a success with our audience (perhaps helped by the fact it was a cold night; a chance to exercise was probably welcome).

I heard one of the older audience members remark, *"this is the kind of game even I can play"*.

What Didn't Work so Well

The webcam was unable to track the motion of the audience, due to the sheer number of players.

Because there were so many, the left side of the webcam image was never empty of people when moving right, and vice versa when they were moving left.

This forced me to fall back onto our backup plan.

The Backup Plan

Due to concerns about changing light levels (this was not actually a problem in the end), and an inability to test the game with a substantial number of people, we had a backup plan in case the webcam didn't work as intended.

If it failed, I would fake the players' input using a MIDI controller, manually following the motion of the crowd.

Faking It

Faking the game's input worked surprisingly well. Only one person I spoke to after the event guessed that I was the one controlling the player avatar.

I would hazard a suggestion that with games it doesn't matter whether there's a direct connection in code between player and game, as long as the player *believes* they are controlling the game.

An alternative view is that by following the players' motion, I made *myself* a concrete link in the connection between the players and the game.

Dissemination & Impact

Generation ZX(X) itself received extensive media coverage, for example: the BBC; the Courier; the National.

Following the *Generation ZX(X)* event, *Breaking Out of the Frame* was run a second time at the opening ceremony of the Dundee V&A alongside the other 2 games developed for the original event.

Breaking Out of the Frame Credits

Director: **Dr Mona Bozdog**

Design; Code; Audio: **Dr Niall Moody**

Art: **Kayleigh MacLeod**
Cara Pearson

Generation ZX(X) Photos: **Erika Stevenson**