Are We Having Fun Yet?

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Intelligent Modelling and Analysis
Overview

✱ Introducing the Thrill Laboratory
  ✱ Motivation and adaptive entertainment
  ✱ Oblivion & Feasibility Study
✱ The I M and A of Thrill
  ✱ emotion classification
  ✱ biosensing application
✱ Parallel Research Strands & Continuing work
Introducing Biosensors

- Placement of small lightweight devices for monitoring of physiological attributes
- Small sensors connected to a recording module
  - physical connectors & bluetooth
- Recording module interfaces with portable computer
- Variety of applications especially in the medical domain e.g. monitoring of bipolar patients
Thrill/Fear discrimination

- Thrill and fear assessed on a 2D scale
  - arousal - how stimulating an experience feels
  - valence - positive or negative emotion
- Numerous sources of data
  - heart rate, rhythm, ECG characteristics
  - large variation between individuals

Is it possible to extract discriminatory features to act as context signals from biosensor data?
Part 1: The Thrill Laboratory
Thrill Laboratory

* Originally an ethnographic study
* MRL with HCI and Aerial for design
  * Fairground Thrill Laboratory
* Alton Towers and Robocoaster
  * Oblivion and Multi-ride investigation
* Collected biosensor and AV data
  * collected for entertainment and ethnographic purposes
Aims

- Development of adaptive rollercoasters using biosensors
- Adapt in proportion to a participant's emotional state
- 'Personalising the user experience'
- Need to ascertain emotional state
Motivation

- User Centric Design -> The Digital Economy
- Adaptive systems
  - dynamic modification
  - adaption linked to how the user perceives an event
- Discover formula for thrill to enhance experiences
  - e.g. science museum attractions
  - entertainment for crowds at large venues
IMA Involvement

- *Can we discriminate between thrill and fear?*
- Generating extreme emotional responses
- High volumes of noisy and real-time data
  - combining multiple input streams in real time
- Development of novel real-time analysis techniques
- Pair analysis with algorithm to adapt the experience based on the classified emotions
IMA Thrill Scientist...

- Large, real-time, noisy, multi-stream datasets
- Required some I M A to understand the meaning of the data
- Plus, I love rollercoasters
Part 2: Thrill Datasets
‘Happenings’

* Fairground Thrill Laboratory
  * audience participation in the ride experience

* Oblivion, Alton Towers 2007
  * audience centric ‘event’ also happened to collect nearly a terabyte of data

* Multi-Ride Feasibility Study, Alton Towers 2008
  * a scientific test for assessment of use of wearable biosensors in emotional classification
The Oblivion Dataset
The Kit

- Head cam to capture 1st person video and microphone for audio
- Heart rate / ECG
- Facial muscle contractions
- Skin resistance (GSR)
- Accelerometer
The Numbers

★ Three input streams of raw data to process
★ Heart rate
   ★ can derive also heart rhythm and variability
★ GSR - galvanic skin response
   ★ rate of change also useful
   ★ electron distribution artefact to be dealt with
★ Accelerometer recording G-forces
Video and Audio

- Helmet mounted head camera
- Automatic image processing
  - facial expression recognition
  - eye movement tracking
  - facial muscle contraction
  - location based context encoded
- Face mounted dynamic microphone
What can we ascertain from this?

- Is it possible to detect specific patterns in the biometrics which validate the transcribed facial expressions?
- Can we develop data fusion techniques to combine the signal data?
- Is it feasible to perform correlation between biosensor and AV data to determine emotional state?
Multi-Ride Data Scenario

- Expansion of the Oblivion experiments
- Much more controlled scenario
  - participants selected based on a pre-defined criterion
  - test to see if assumptions from oblivion generalise
- Improved AV equipment and more flexible storage of devices
- Four days, 16 people, 12 different rides, lots of hard work!!
Ensuring Scientific Rigour

- Improved recording of data
- Selection of people who are deemed psychologically and physically similar
- Eliminate as many potential sources of bias as possible
- Fresh electrode application, precision in sensor application
- Attempted to record as much as possible!
As a result

- Recorded some ‘normal’ data additionally
  - participants wore the kit for most of the day
- 10 full datasets
  - one of the rollercoasters wiped out our biosensing units
- Additional measurements of facial muscles
- Great experience doing the field work for yourself
Part 3: The IMA of Thrill
The I M A of Thrill Laboratory

- Intelligent technique development
  - classification, clustering and correlation
  - adaptive algorithms

- Modelling and Simulation
  - simulation of novel ride design

- Analysis of current datasets
  - generation of new datasets based on what is discovered from the existing ones
Analysis of Existing Data

- Derive signals from the raw data
- Basic derivatives
- Detection of heart rhythm
- Application of entropy metrics such as information gain
- Assess suitability of techniques used to combine the data
- [Navapat’s research]
SCARIEST RIDE SEGMENT
Intelligent Techniques

- Novel application for the Dendritic Cell Algorithm
  - classify, fuse and correlate
  - why I got asked initially
- Processed motifs as signals, AV data as antigen
- Fuzzy systems and inference
  - link between emotional state and decision making
- Real-time adaptive algorithms?
Development of Novel Methods?

- Homeostatic systems
  - based on models of inflammation
- Need to understand the data more thoroughly before such methods can be developed
- Integrated and automated process
  - but has to be as safe as possible!
Modelling Thrill

- Ride design is costly and safety critical
- Develop simulation of the process
  - pairing of data correlation and ride adaption
- Simulation of people behaviour in different contexts
  - on ride, in queue, after ride etc
- Model the context of a ride
Part 4: Novel Directions
Novel Directions

- Biosensing Tent
- Bucking Bronco in the lab
- Ski Thrill
- CALS - Context Aware Linguistic Systems
- Collaboration with statistics department
- Many more to emerge as funding for this research increases steadily
- Doctoral Training and Digital Economy
Bucking Bronco Testbed

* Needed a test bed in order to try out ideas
  * safe, controllable, entertaining and flexible
* Just be careful what you wish for!
* Can perform controlled experiments
  * also examine the influence of external factors for the ride experience
  * lighting, music, smell, ambience - what influence have these factors?
The Language of Thrill

- Not simply the biosensor data
- The language used by participants is a rich source of information
- Modelling of corpus linguistics of the thrill participants
- Feed this information back into the system
  - paired with the facial expression data
Thrill of Snowsports

- New project with Jon G to run in parallel
  - Bridging the Gaps Feasibility study
- Safety on the slopes
- Thrill slope hotspots
- Prevent piste overcrowding
- Monitoring of competitors at events
  - feedback data to spectators
Wider implications

* There are numerous sensible applications for the use of real-time emotion discrimination
  
  * mental illness and healthcare
  * stress monitoring in safety critical occupations

* Lots of fun applications too (how many can I find!)

  * adaptive movies
  * enhanced gaming
  * immersive and pervasive media
Summary

- Introduced Thrill Laboratory
  - adaptive rollercoasters
- Analysis of Thrill Data
- Intelligent technique development for thrill
- Modelling and simulation of numerous aspects
- Current and future research
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