

## Dr Soumya C. Barathi

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**Research Interests** I have a strong interdisciplinary research background covering Human-Computer Interaction (HCI), health, engineering, and psychology. I build interactive digital applications and use psychophysical training techniques such as gamification to enhance performance, adherence, and user experience. I devise and test novel, robust multi-sensor approaches to track, analyse, and visualise user perception and experience of digital applications, reflected in their emotions (affective state) at run time. I use experimental analytical techniques to investigate correlates of affective states while using digital interventions. My research goal is to develop interactive personalised digital applications that are capable of providing optimal user experience by adapting themselves according to the user's affective state. My current research investigates the use of virtual reality exercise controlled games (VR exergames) to motivate healthy and sustainable exercise behaviour. My primary research interests are:

*Interactive Immersive Media Applications;*

*Affective Computing.*

### Employment

Marie Curie FIRE and CAMERA Researcher

University of Bath

October, 2016 - Present

I'm currently a Marie Curie FIRE (Fellow with Industrial Research Enhancement) researcher in the Department of Computer Science at the University of Bath. I was awarded the FIRE Fellowship via a competitive international process. As part of my Fellowship I have been trained in public engagement, handling the media, and other professional skills including project management. My research has focused on improving performance, user experience, and measuring and analysing affect in high intensity VR exergaming. The FIRE webpage is here: <https://www.csct.ac.uk/msca-fire>

I am also a member of CAMERA (Centre for the Analysis of Motion, Entertainment Research & Applications), a multi-disciplinary research centre bringing together visual computing, machine learning, human-computer interaction, health, human performance and engineering researchers. I have collaborated with my colleagues in CAMERA and presented my research on numerous occasions to an interdisciplinary audience. The CAMERA webpage is here: <https://www.camera.ac.uk>

### Education

#### PhD in Human Computer Interaction

October 2016 to May 2020

University of Bath, UK

*Title: Interactive Feedforward in High Intensity VR Exergaming*

*Advisors: Dr Christof Lutteroth, Prof Eamonn O'Neill, and Dr Michael Proulx*

*Examiners: Prof Stephen Payne and Prof Kirsten Cater*

#### Bachelor of Technology in Computer Science and Engineering, First Class,

July 2011 to May 2015

SRM University, India

### Summer School

#### Immersive Technologies Summer School by VR & AR Oxford Hub University of Oxford, June 2018

We developed a virtual reality application to help people alleviate stage fright and practise their presentation in front of an audience. Together we worked to design and build this application to provide an effective platform to practise presentations while encouraging eye contact with the audience.

### Award/ Grant

EU Marie Skłodowska-Curie Actions (MSCA FIRE) Fellowship 2016-2020

My PhD research was funded by the EPSRC Centre for Doctoral Training in Digital Entertainment (CDE), EP/L016540/1, and the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 665992.

### **London Hopper Research Spotlight Finalist Prize, 2018**

I presented my exergaming research at the Research Spotlight Competition and won the Finalist Prize. My presentation was on using a motivational psychophysical training method called interactive feedforward in high intensity VR exergaming.

### **Publications (Peer reviewed)**

A note on publication venue: the ACM Conference on Human Factors in Computing Systems (CHI) is consistently ranked as one of the leading forums for dissemination of research results and covers the broad spectrum of research in Human Computer Interaction. Papers in CHI are refereed as full papers, and have an acceptance rate of around 15-25% each year.

**ACM CHI Conference** → *Top tier conference in Computer Science*  
(Acceptance < 25%)

### **Affect Recognition using Psychophysiological Correlates in High Intensity VR Exergaming**

*Proceedings of the 2020 CHI Conference on  
Human Factors in Computing Systems;*

*Recognising the affective state of VR exergame players could enable us to personalise and optimise their experience. However, affect recognition based on psychophysiological measurements for high intensity VR exergames presents challenges as the effects of exercise and VR headsets interfere with typical measurements. This paper presents novel predictors of affect based on gaze fixations, eye blinks, pupil diameter, and skin conductivity for affect recognition in high intensity VR exergaming.*

<https://dl.acm.org/doi/abs/10.1145/3313831.3376596>

### **Guidelines for Affect Elicitation and Tracking in High Intensity VR Exergaming**

*Momentary Emotion Elicitation and Capture Workshop at CHI 2020 Conference*

*This position paper on VR exergaming provides an overview of advances made in affect elicitation and tracking. It outlines guidelines for evoking underwhelming, overwhelming, and optimal affective states and tracking the affective state using psychophysiological measurements in high intensity VR exergaming. It discusses the research challenges that need to be addressed to implement affectively adaptive high intensity VR exergaming. [https://meec-ws.com/papers/MEEC\\_2020\\_paper\\_10.pdf](https://meec-ws.com/papers/MEEC_2020_paper_10.pdf)*

### **Interactive Feedforward for Improving Performance and Maintaining Intrinsic Motivation in VR Exergaming**

*Proceedings of the 2018 CHI Conference on  
Human Factors in Computing Systems;*

*This paper presents a novel method called interactive feedforward, which is an interactive adaptation of the psychophysical feedforward training method where rapid improvements in performance are achieved by creating self-models showing previously unachieved performance levels. Interactive feedforward was evaluated in a cycling-based VR exergame where players interacted and competed with their self-model at real-time in a VR experience. Interactive feedforward led to improved exercise performance while maintaining intrinsic motivation. <http://dx.doi.org/10.1145/3173574.3173982>*

### **Datasets and Analyses**

### **Datasets and Analyses for Affect Recognition using Psychophysiological Correlates in High Intensity VR Exergaming**

*University of Bath*

*This repository contains the datasets of two experiments that investigate the use of a range of sensors for affect recognition in a VR exergame. The first experiment compares the*

*impact of physical exertion and gamification on psychophysiological measurements during rest, conventional exercise, VR exergaming, and sedentary VR gaming. The second experiment compares underwhelming, overwhelming, and optimal VR exergaming scenarios.*  
<https://doi.org/10.15125/BATH-00758>

## Peer Review

### Conference Peer Reviewer

*Late Breaking Work track of ACM CHI Conference*

## Research Training and Skills

### Hardware and Systems Integration

I have reverse engineered bespoke hardware to make it inter-operable with my game. I created a VR exergaming application by integrating the Lode Excalibur Sport exercise bike with the game developed in Unity using the serial port interface. I created a multi-sensory affect tracking system using a set of psychophysiological monitors. I measured the tonic skin conductance using the Shimmer3 Consensys GSR development kit and I monitored the pupillometry measures such as blink rate and pupil dilation using a FOVE VR headset which has eye tracking capabilities.

### Software Development and Game Design

I have developed VR exergaming applications for my various research experiments by using the Unity game engine and a variety of VR headsets such as HTC Vive and FOVE. I have implemented a novel psychophysical training technique called social interactive feedforward in VR exergaming. It allows players to train and compete with virtual enhanced models of their friends thus giving them an interactive, social VR exergaming experience. I have simulated underwhelming, overwhelming, and optimal exergaming scenarios by using game play and aesthetics. I built a novel multi-sensory affect tracking system and recorded the data at run-time of the exergaming experiments. I implemented a ray casting system in the VR exergame using the FOVE VR headset to track gaze fixations. I used ray casting to detect the gameplay-related components corresponding to the point of gaze, such as a timer and speed indicator.

### Experimental Design

I have done a number of literature reviews, and proposed and implemented the experiment design, and programmed the exergame design for the various experiment conditions. I have conducted user studies involving over 100 participants, giving me a strong grasp of experimental design and running user studies in digital health.

### Quantitative analysis

I have extensive experience of quantitative analysis such as ANOVA and regression models using R and JASP.

### Data Science and Analytics

I am taking a suite of data science courses covering topics including data management, visualisation, and data analysis using R and Python.

### First-aid Training to Conduct Digital Health User Studies

I did a first-aid training course offered by the British Red Cross to run user studies involving high intensity exergaming. The course covered how to administer first aid to a wide range of accidents, injuries, and other health problems such as cardiac arrest including the use of an automated external defibrillator (AED).

### **Media Training – TV & Radio**

I attended a workshop offered by the Learning and Teaching Hub at Bath that trained me how to communicate effectively to a non-specialist audience.

### **Entrepreneurship Courses**

I have attended several workshops on entrepreneurship as a part of my FIRE industrial research fellowship training, for example; real world translation of research ideas; delivering projects while winning over stakeholders; and knowing your audience and communicating confidently.

### **Teaching and Supervision**

I supervised an MSc Psychology student who worked with me for his placement year. He successfully completed his project on exploring the impact of using different virtual environments in a VR exergame under my supervision. I also taught undergraduate students how to conduct user studies and supervised their lab sessions. I have conducted a work experience programme for Kingswood School students at the University of Bath. I organised events to tutor them on experimental design, user studies, and statistical analysis. I evaluated their performance and conveyed their results back to the school.

### **Public Engagement, Guest Lecture, and Talks**

I have given talks on my research to interdisciplinary audiences, non-specialists, the general public, and different age groups including primary and secondary school children. I modulate my presentation and discussion based on the background of my audience. I communicate my research accessibly and inclusively, avoiding confusing jargon and my talks have always been well received.

### **Bath Taps into Science, 2017**

The Bath Taps into Science festival aims to inspire children, families, and adults with hands-on workshops and demos on science, technology, engineering, and maths (STEM). The Bath Taps into Science event in 2017 recorded 8,500 attendees.

I exhibited a multiplayer virtual reality game in collaboration with Dr Daniel J. Finnegan called Dungeon Escape to primary school children at the Bath Taps into Science event. The goal of the game is to run away from a dungeon while an invisible demon chases them. One player wears a VR headset while another carries a physical device that acts as a torch to light up the dungeon. Both players control the game character and must cooperate to escape. This project used cooperative game play in a stressful, spooky VR game. The school students thoroughly enjoyed the game and were fascinated by how VR works.

### **CDE Research Showcase – BU Festival of Learning, 2017**

The Festival of Learning is a research exhibition event at Bournemouth University (BU) and an opportunity to showcase demos and share research ideas with a diverse audience. I represented the CDE (Centre for Doctoral Training in Digital Entertainment) in the CDE Research Showcase held at the Festival of Learning and exhibited my exergaming research to the general public.

### **CDE Event at the Digital Catapult Centre, 2018**

I presented my research on VR Exergaming at the Digital Catapult Centre in London. I discussed how interactive feedforward is effective in improving performance while maintaining motivation in high intensity VR exergaming. It was a great opportunity to network with industry partners and research experts.

### **CHI 2018 Conference at Montreal, Canada**

I presented my research paper on “Interactive Feedforward for Improving Performance and Maintaining Intrinsic Motivation in VR Exergaming” at the CHI 2018 Conference in Montreal, Canada. I also attended courses by Dr Lennart Nacke on gamification as a tool and technique to motivate users and how to write impactful research papers.

### **RHS: Festival of Ideas, 2018**

I was invited to present a guest lecture at the Festival of Ideas 2018 at the Royal High School, Bath. My talk was on the history of VR, applications of VR in fields such as education, and my exergaming research. The students found my lecture captivating and enquired about the opportunities available to pursue a research career.

### **Virtual Presentation, CHI 2020**

I have uploaded a pre-recorded presentation on my research paper “Affect Recognition using Psychophysiological Correlates in High Intensity VR Exergaming” to the ACM Digital Library. The conference was cancelled due to Covid-19.

### **Entrepreneur**

I am co-founding a spin-out company based on my research on high intensity VR and non-VR exergames with colleagues at the University of Bath. Our aim is to improve player experience, exercise performance, and adherence using digital health interventions. As this project develops, it will facilitate industry collaboration and enable me to network with potential industry partners. I will also apply for industrial research funding and grants such as the UKRI’s Healthy Ageing Challenge and Audience of the Future.

### **Previous Employment Experience**

Business Analyst

Unisys  
June 2015 - June 2016

I was involved in the design, development, business analysis and testing of USFN (Unisys Secure Family Net); see below. As a member of the user experience team, I worked on enhancing the usability of the application by logically grouping the data fields and creating digital mockups of the screens.

ADM Intern

Unisys  
January 2015 - June 2015

I worked on the project USFN which stands for Unisys Secure Family Net. It is a robust and flexible system designed to address the unique needs of child welfare agencies. I was involved in business analysis in which the business rules were documented based on the client’s requirements and communicated to the development team.