Dr Soumya C. Barathi

Research Interests I have a strong interdisciplinary research background covering Human-Computer Interaction (HCI), health, engineering, and psychology. I build interactive immersive media 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 states) 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:

Exergaming;
Immersive Media Applications;
Affective Computing.

Employment

Lecturer and IROHMS Researcher — Cardiff University
October, 2021 - Present

I am a Lecturer at Cardiff University. I am part of a vibrant and diverse research community in the School of Computer Science and Informatics and a researcher at IROHMS. IROHMS is a research group supported by an accelerator grant in Cardiff University that investigates human centred robotics and human computer interaction. I build and investigate the effectiveness of immersive and interactive applications. I am the module leader of Fundamentals of Computing with Java (CM6121). My webpage is here: `https://www.cardiff.ac.uk/people/view/2585229-Barathi-Soumya`.

Founder and CEO — Exergaming Ltd
December, 2020 - Present

I founded a start-up called Exergaming Ltd. Under my leadership as the CEO of Exergaming Ltd, my team and I built an innovative prototype of an exercise controlled game. I also developed experience in pitching business ideas, market analysis, and business planning. Out of hundreds of applicants, I got selected to present at the Creator Fund competition which is the UK's leading university start-up competition and the GradInvest Showcase 2021. Our webpage is here: `https://www.exergaming.net`.

LD15 Cohort Member — Entrepreneur First, London
September, 2020 - January, 2021

I was accepted into the highly competitive Entrepreneur First (EF) programme which has an acceptance rate of less than 3%. EF is an international talent investor and they provide an effective environment to build a technology start-up. I developed a valuable network of a wide range of industry experts and business leaders. The EF webpage is here: `https://www.joinef.com/the-programme`.

Previous Employment Experience

Marie Curie FIRE and CAMERA Researcher — University of Bath
October, 2016 - September, 2020

I was 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 was 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`.

Business Analyst — Unisys
June 2015 - June 2016
I was involved in the design, development, business analysis, and testing of USFN (Unisys Secure Family Net). 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.

Education

PhD in Human Computer Interaction (HCI)
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

ESRC IAA CRoSS Scheme via the Devil's Den pitch event(£5000), 2023
I led a team of computer vision engineer, game developer, and a software engineer and we have successfully built a working prototype of the hardware-independent computer vision-based exergame. The exergame will just use cameras on laptops or mobile phones to track exercise movements.

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 Sklodowska-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`

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

Skills

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 HCI.

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.

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.

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

Resource Allocation and Project Management
As the CEO of my start up, Exergaming Ltd, I have gained experience in judicious resource and project management. I used a lean product development approach to optimise our time and financial resources while developing a prototype exergame. I led a team of game developers and designed a novel exercise controlled game by partnering with a game studio.

Industrial Research Training
I have attended several workshops as 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.

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 Correlatesin High Intensity VR Exergaming" to the ACM Digital Library. The conference was cancelled due to Covid-19.