Unnikrishnan R

Graduate Student, Aarhus University

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Experience

2020 – Present **PhD Fellow**, *Extended Reality & Robotics (xR^2) Lab*, Aarhus University.
I work at the intersection of virtual reality, haptics and learning analytics to investigate effective ways of designing immersive and user adaptive skill training systems.

2010 – 2020 **Software Engineer**, *AMMACHI Labs*, Amrita University.
I am a Software Engineer leading the Virtual Reality & Serious Games group at AMMACHI (Amrita Multi-Modal Applications & Computer Human Interaction) labs focusing on building virtual and augmented learning environments to teach vocational, computational thinking & social problem solving skills.

2015 **Visiting Researcher**, *CHILI Labs*, École Polytechnique Fédérale de Lausanne.

2009 – 2010 **Intern**, *Sakshat Amrita Vocational Education Project*, Amrita University.

Projects

2010 – 2020 **Visuo-haptic Simulators for Vocational Training**.

- Led a team of four software engineers and worked with mechatronics engineers to build the reinforced bar bending simulator, currently deployed at five Larsen & Toubro's (L&T) Construction Skill Training Institutes. After getting requirements from L&T expert trainers, developed the virtual learning scenarios, guided visual cues and real time mesh (bending) deformation graphics in Unity3D.
- Developed simulation software using OpenGL/CHAI3D/Qt for different tools and machinery (drillpress, tablesaw, file, handplane & ratchet) and the APIs for interfacing the simulations with the "APTAH" (linear movement) and "CHAKRA" (rotary movement) haptic feedback devices. Helped in conducting pilot studies of the simulators and in public engagement activities where the technology was promoted among school and college students.
- Developed a prototype vision based system for simulating a Jigsaw machine with passive haptics (OpenGL + OpenCV). Currently porting the technology into virtual reality in Unity3D with the help of Vive trackers.
- During internship, created a prototype for a haptic wood carving simulator using the Novint Falcon haptic device and Chai3D SDK, developed a constructive solid geometry based hand drill simulator prototype using H3D and OpenCSG libraries, and created prototypes combining H3D with IRRLicht graphics and Nvidia PhysX engines.

2015 – 2020 **Learning Technologies/Tools for STEM Education**.

- Developed a board game called "Haathi Mera Saathi" (My Elephant Friend) to teach computational thinking concepts to children in rural India. An associated PC/Android game for introducing Python programming is under development in Unity3d.
- Developed initial electronics prototypes of an Arduino shield for capacitive touch sensing called "Kappa", developed middleware in C# for serial communication and keyboard emulation, and developed curriculum to teach students to create physical game/music controllers using the shield. Conducted pilot user evaluation studies in schools to measure student perception of the system as well as learning gains.

2019 **Social Robots for Behavioral Change**.

- Led a team of software and mechanical engineers in collaboration with Glasgow University to develop a social robot to encourage children in rural areas to engage in proper handwashing behavior, in order to reduce diseases caused by poor hand hygiene.
- Developed TCP socket based communication stack for robot control, a custom Bluetooth Android library for Unity, robot mouth animations in Unity as well as the initial prototypes of the robot.
- Conducted user evaluation (Wizard of Oz) studies in a tribal school using objective and subjective measures of behavior change.

2013 – 2018 **Virtual Motorcycle Repair Trainer**.

- Developed prototypes for visualizing the layout of motorcycle parts, allowing for interactive labeling and assembly operations with gestures using the Leap motion sensor & the zSpace virtual holographic display.
- Lead a team of software engineers who created a virtual reality environment where users learn to identify motorcycle parts through interactive labeling and learn the procedural skills of dismantling the exhaust pipe. Assisted the team in designing the evaluation study for measuring perception and learning gain for a parts label memorization task in virtual reality versus conventional media.

2017 **Tangible User Interfaces (TUIs) for Education**.

- Developed and pilot tested prototype TUI for teaching surveying skills necessary for toilet construction, targeting women in villages. The prototype was built using Unity3D, OpenCV, Windows Inter-Process Communication and Chilitags marker library.
- Used participatory design methods to work with local facilitators to develop the prototype, the pedagogical approach and the pilot study.
- In collaboration with researchers at EPFL's CHILI labs, developed a tangible computer game to teach carpentry students efficient packing strategies in planning woodcuts. Utilized OpenCV & CGAL libraries.

2013 – 2014 **Serious Games for Rehabilitation & Social Awareness**.

- Led a team of electronics, mechanical and software engineers in collaboration with rehabilitation specialists to design & build the Amrita Balance training system ("AMBA") to help patients with balance neuropathies regain static stability.
- Developed AMBA's device drivers, sensor data storage system and also designed rehabilitation exercise games in Unity3D.
- Developed a "Waste sorting" game as part of an exhibit on the Clean India Campaign. Kinect skeleton data of users at the exhibit was used to control 2D avatars in Unity3D which 'grabbed' virtual waste and sorted them into the right bins. Also assisted in conducting a survey of the players.

2012 – 2013 **Interactive Art Installation**.

- Developed software to identify user interaction with a water fountain using multiple Kinect cameras and dynamically render music in PureData.

Community Work

2015 – 2019 **Amrita Self Reliant Villages (ASeRVe)**.

- Conducted digital literacy classes and sanitation awareness campaigns, documented local music and medical know-how in the villages of Nani Borwai (Gujarat), Kanti (Haryana) and Indpur (Himachal), and setup a digital literacy center in Pandori (Jammu & Kashmir).
- Coordinated construction skill training of over 30 ladies in Nani Borwai village, helping them build 10 toilets for their community.
- Introduced basics of robotics & electronics to village children to help them build 'scribblebots' from trash and culturally relevant story telling robots using LEGO WeDo kits.

2011 – 2018 **Amala Bharatham (Clean India) Campaign**.

- Regular volunteer for Amala Bharatham clean-up drives around Kerala.

Education & Qualifications

2013 **UGC-NET Lectureship**, *University Grants Commission*, Qualified for lectureship in Computer Science through National Eligibility Test.

2007–2010 **Master in Computer Applications**, *Amrita School of Engineering*, GPA - 8/10.

2004–2007 **BSc in Computer Science**, *Amrita School of Arts and Sciences*, GPA - 8.78/10, (3rd Rank).

Awards

2019 **Best Social Robot**, Won 1st prize in the social robotics competition 'Socialis Impremiere' at the 2019 IEEE Ro-Man conference, New Delhi..

Technical Skills

Programming C, C++, C#, Java, Python.

IDEs Visual Studio, Android Studio, Eclipse.

Graphics Unity3D, OpenGL, IRRLicht, Processing.

Sound Generation Puredata, OSC

Haptics Chai3D, H3DAPI.

Electronics Arduino, Fritzing.

Web Javascript, Electron.js, Flask.

Vision OpenCV, Kinect/Leap SDKs, AForge.NET.

Publications

- Sooraj K. Babu, A. Parameswari, **R. Unnikrishnan**, E. S. Rahul, Deepu D. Sasi, K. Ayyappan, Roopak Seshadri, Rao R. Bhavani. "Igniting the Maker Spirit: Design and Pilot Deployment of the Kappa Tangible Electronics Prototyping Kit." In the IEEE Tenth International Conference on Technology for Education (T4E), pp. 23-26. IEEE, 2019.
- **R. Unnikrishnan**, Amol Deshmukh, Shanker Ramesh, Sooraj K. Babu, A. Parameswari, Rao R. Bhavani. "Design and Perception of a Social Robot to Promote Hand Washing among Children in a Rural Indian School". In the 28th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN). IEEE, October, 2019.
- Amol Deshmukh, Sooraj K. Babu, **R. Unnikrishnan**, Shanker Ramesh, A. Parameswari, Rao R. Bhavani. "Influencing Hand-washing Behaviour With a Social Robot: HRI Study With School Children in Rural India". In the 28th IEEE International Conference on Robot and Human Interactive Communication (RO-MAN). IEEE, October, 2019.
- A. Parameswari, Sooraj K. Babu, **R. Unnikrishnan**, Rao R. Bhavani. "Scratching Out Problems: Exploring the Use of Computational Thinking for Social Work in Rural India." 10th IEEE International Conference on Technology for Education (T4E), pp. 16-19. IEEE, 2018.

- A. Balakrishnan, S. Sheshadri, N. Akshay, **R. Unnikrishnan**, S. Kongeseri and Rao R. Bhavani (2018). "Information and Communication Technology for TVET : Enhancing Scale, Quality and Reach of TVET in India." In: McGrath S., Mulder M., Papier J., Suart R. (eds) Handbook of Vocational Education and Training: Developments in the Changing World of Work. Springer, Cham.
- **R. Unnikrishnan** and Rao R. Bhavani, "Tangible User Interface for Sanitation Education in Rural India : Design and Preliminary Observations." 18th International Conference on Advanced Learning Technologies, IEEE, 2018.
- Sooraj Babu, Sooraj Krishna, **R. Unnikrishnan** and Rao R. Bhavani, "Virtual reality learning environments for vocational education : A comparison study with conventional instructional media on knowledge retention." 18th International Conference on Advanced Learning Technologies, IEEE, 2018.
- Menon, Balu M., Deepu, S., Harish, M.T., **R. Unnikrishnan**, Gayathri, M., Marco, S., Shanker, S., Vishnu, P., Nishok, S., Mahima, M. and Rao R. Bhavani, "Virtual Rebar Bending Training Environment with Haptics Feedback." In Proceedings of the Advances in Robotics, p. 37. ACM, 2017.
- Menon, Balu M., **R. Unnikrishnan**, Alexander Muir, and Rao R. Bhavani, "Serious game on recognizing categories of waste, to support a zero waste recycling program." In Serious Games and Applications for Health (SeGAH), 2017 IEEE 5th International Conference on, pp. 1-8. IEEE, 2017.
- Jose, James, **R. Unnikrishnan**, Delmar Marshall, and Rao R. Bhavani, "Haptics enhanced multi-tool virtual interfaces for training carpentry skills." In Robotics and Automation for Humanitarian Applications (RAHA), 2016 International Conference on, pp. 1-6. IEEE, 2016.
- N. Amritha, Menon M. Mahima, K. Namitha, **R. Unnikrishnan**, Mohan T. Harish, MD Sankaran Ravi, and Rao R. Bhavani, "Design and development of balance training platform and games for people with balance impairments." In Advances in Computing, Communications and Informatics (ICACCI), 2016 International Conference on, pp. 960-966. IEEE, 2016.
- **R. Unnikrishnan**, N. Amritha, Alexander Muir, and Bhavani Rao, "Of Elephants and Nested Loops: How to Introduce Computing to Youth in Rural India." In Proceedings of the The 15th International Conference on Interaction Design and Children, pp. 137-146. ACM, 2016.
- Jose, James, **R. Unnikrishnan**, Delmar Marshall, and Rao R. Bhavani, "Haptic simulations for training plumbing skills." In Haptic, Audio and Visual Environments and Games (HAVE), 2014 IEEE International Symposium on, pp. 65-70. IEEE, 2014.
- Ranjith, R., Nagarajan Akshay, **R. Unnikrishnan**, and Rao R. Bhavani, "Do It Yourself Educational Kits for Vocational Education and Training." In Proceedings of the 2014 International Conference on Interdisciplinary Advances in Applied Computing, p. 40. ACM, 2014.
- N. Akshay, S. Deepu, E. S. Rahul, R. Ranjith, J. Jose, **R. Unnikrishnan**, Rao R. Bhavani, "Design and Evaluation of a Haptic Simulator for Vocational Skill Training and Assessment", 39th Annual Conference of the IEEE Industrial Electronics Society, Vienna, 2013.

- **R. Unnikrishnan**, K. Moawad, and Rao R. Bhavani, "A physiotherapy toolkit using video games and motion tracking technologies", Global Humanitarian Technology Conference: South Asia Satellite (GHTC-SAS). IEEE, 2013.
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References

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