Course Code	TBD
Course Name	Wearable Applications, Research, Devices, Interactions (WARDI)
Credits	4
Course Offered to	UG/PG/M.Tech from all departments
Course Description	This is a course about the current paradigm of Wearable Computing. In this course, we will cover the origins, pioneering contributions, and principles of Wearable Computing. With this foundation, we will initiate our exploration into the space by learning how to design physical (device form factor), digital (applications) as well as human (interaction techniques) aspects of Wearables. You will develop the skills needed to conduct design of these three interrelated elements and also get a chance to apply them on short assignments and student-selected group projects. We will also discuss and critique both seminal and cutting-edge research in the domain to help you identify opportunities for new research that may begin with your class projects.

Pre-requisites

Mandatory	Desirable	Other
Android programming	Arduino programming, Circuit design	Sewing and stitching

Post Conditions/Learning Outcomes

CO1	CO2	CO3	CO4	CO5
Identify the motivation, guiding principles, and challenges of Wearable Computing.	Develop skills pertaining to the design of a holistic interactive wearable system comprising of the physical, digital, and the human aspects.	Critique research published on novel applications, design of form factor, and sensor-based interactions of wearable computers.	Generate new project ideas that illustrate effective use of wearables for a problem you identify.	Plan and produce proof-of-concepts to test hypotheses about a wearable solution.

Weekly Plan (L: Lecture, D: Reading discussion, A: In-class hands-on activity, W: Project work time)

Week Number	Topic	Assignments/Readings	COs Met
1	(LD) Introduction to Wearable Computing; Course overview.	Additional material: R5, R6, R28, R29, R30	CO1
	(A) Looking inside technology		CO2
2	(LD) Applications of Wearable Technology	Due: Reading summary for R11/R12/R13/R15/R16	CO3, CO4
	(A) Manual Prototyping		CO2
3	(LD) Emerging opportunities for wearables; Project introduction	Due: Reading summary for R4/R7	CO3, CO4
	(A) Field observations and brainstorming		CO2
4	(LD) Form and function	Due: Project proposal draft;	CO1
	(A) Wearable Prototyping		CO2, CO5
5	(LD) Designing for wearability	Due: Reading summary for R9/R10	CO1
	(A) Arduino Prototyping 1		CO2
6	(LD) Challenges of Wearable Computing	Due: Revised project proposal Due: Reading summary for R2 both parts Additional material: R32/R33	CO1
	(A) Arduino Prototyping 2		CO2, CO5
7	(LD) Intelligent agents I: Sensing, Activity Recognition	Due: Reading summary R34/R47/R48 Additional material: R49	CO3
	(A) Thresholding based event detection		CO2
8	(LD) Intelligent agents II: Just-in-time Information Retrieval, Context awareness, Capture and Access	Due: Reading summary for R18/R14/R40	CO3
	(A) Context-aware prototyping		CO2, CO5
9	(LD) Input techniques	Due: Reading summary for R19/R20/R37/R38/R39/R46	CO3, CO4
	(W)		CO5
10	(LD) E-textiles	Due: Project midway report Due: Reading summary for R25/R26/R27	CO4
	(W)/(A) Soft-good prototyping		CO2,CO5
11	(LD) Output: Audio, visual, tactile	Due: Reading summary for R21/R24	CO3, CO4
	(W)		CO5
12	(LD) AR and VR	Due: Reading summary for R22/R23/R50	CO3, CO4
	(W)		CO5
13	(LD) Privacy and Social Acceptability	Due: Reading summary for R41/R42/R43/R44	CO1, CO3
	(W) Project demos	Due: Project report draft	CO5

Assessment Plan

Type of Evaluation	% Contribution in Grade	Details
Assignment	40	Assignments are a means to put the theory to practice. They are also a chance to learn or sharpen a skill. With upto 8 assignments either to be finished in-class or out-of-class individually (sometimes in pairs) you will be better equipped for taking on an open-ended problem in your project.
Project (End-Sem = Project Demos)	40	This is your opportunity to explore the paradigm of wearable computing, create new artifacts, and, in doing so, solve a problem. You will pick a project topic based on the theme of the semester then research, design, build, and evaluate a wearable system in a team of upto 3 students. Your project will be evaluated on Novelty, Thoroughness, and Presentation.
Paper Critique	10	Each paper critique involves writing a one-page critique and/or participating in panel discussion of an article/chapter from the reading list. Each critique is worth 5 points, so you have to do at least two. If you do more then the highest two points will be considered.
Class Participation	10	Attending and participating in classes is expected of all students. Because you bring in a unique perspective, sharing it with your peers may help them understand the material better. You may also be asked to provide constructive criticism only to the work presented by your peers during class period.

Grading Rubrics

Project (40%)	Assignment (4 x 10%)	Paper Critique (2 x 5%)
Proposal - *5%*	In-class activity - *5%*	(writeup) Summary in own words - *1%*
Midway checkpoint: 1 min video - *5%*, writeup - *5%*	Out-of-class follow up activity/writeup - *5%*	(writeup) Reflection: *1%* Analysis of strengths and weaknesses in the argument
Final writeup - *10%*		(writeup) Transfer: *1%* How would you update the argument for the contemporary world? How does the work link to other readings/technologies?
Final presentation: 3 min video - *5%*, live demo - *10%*		(writeup/site) Rate the reading: *1%* Stimulating or boring? Easy to understand or difficult?
(Bonus points) Mother of all demos* - *10%*		(Panel) Participation in discussion - 1%

** https://en.wikipedia.org/wiki/The_Mother_of_All_Demos*

Guidelines

You are encouraged to refer to external resources including but not limited to ones provided below. However, any use of written text/source code/media/any other intellectual property in your submissions and presentations should be properly documented alongwith citations. When in doubt please follow the guidelines provided by the Institute https://www.iiitd.ac.in/academics/resources/academic-dishonesty

Resource Material

Code	Type	Title
R1	Reference	Siewiorek, D. et al. 2008. Application Design for Wearable Computing. Synthesis Lectures on Mobile and Pervasive Computing. 3, 1 (Jan. 2008), 1–66.
R2	Research Article	Starner, T. 2001. The challenges of wearable computing: Part 1 & 2. Micro, IEEE (2001).

R3	Reference	Krumm, J. (2010).Ubiquitous computing fundamentals. Boca Raton: Chapman & Hall/CRC Press.
R4	Research Article	Man-computer Symbiosis, Chapter 5, The New Media Reader
R5	Internet Resource	Wearable Computing Tutorial: http://www.iswc.net/iswc03/iswc2003-intro-tutorial.pdf
R6	Internet Resource	Brief history of wearable computing: https://www.media.mit.edu/wearables/lizzy/timeline.html
R7	Research Article	Weiser, Mark. "The computer for the 21st century." Scientific american 265.3 (1991): 94-104.
R8	Reference	Pg 84-95 Norman, Donald A. *Emotional design: Why we love (or hate) everyday things*. Basic Civitas Books, 2004.
R9	Research Article	Gemperle, F. et al. 1998. Design for wearability. Wearable Computers, 1998. Digest of Papers. Second International Symposium on (1998), 116–122.
R10	Research Article	Bodine, K. and Gemperle, F. 2003. Effects of functionality on perceived comfort of wearables. 2012 16th International Symposium on Wearable Computers (2003), 57–57.
R11	Research Article	Stein, R. et al. 1998. Development of a commercially successful wearable data collection system. Wearable Computers, 1998. Digest of Papers. Second International Symposium on (1998), 18–24.
R12	Research Article	Carr, C.E. et al. 2002. A wearable computer for support of astronaut extravehicular activity. *Wearable Computers, 2002.(ISWC 2002). Proceedings. Sixth International Symposium on* (2002), 23–30.
R13	Research Article	Jebara, T. et al. 1997. Stochasticks: Augmenting the billiards experience with probabilistic vision and wearable computers. Wearable Computers, 1997. Digest of Papers., First International Symposium on (1997), 138–145.
R14	Research Article	Abowd, G.D. et al. 1997. Cyberguide: A mobile context-aware tour guide. Wireless networks. 3, 5 (1997), 421–433.
R15	Research Article	Guo, A. et al. 2015. Order Picking with Head-Up Displays. Computer. 48, 6 (Jun. 2015), 16–24.
R16	Research Article	Ockerman, J.J. and Pritchett, A.R. 1998. Preliminary investigation of wearable computers for task guidance in aircraft inspection. Wearable Computers, 1998. Digest of Papers. Second International Symposium on (1998), 33–40.
R17	Research Article	Seim, C. et al. 2014. Passive Haptic Learning of Braille Typing. Proceedings of the 2014 ACM International Symposium on Wearable Computers (New York, NY, USA, 2014), 111–118.
R18	Research Article	Abowd, G.D. and Mynatt, E.D. 2000. Charting past, present, and future research in ubiquitous computing. ACM TOCHI. 7, 1 (2000), 29–58.
R19	Research Article	Sturman, D.J. and Zeltzer, D. 1994. A survey of glove-based input. Computer Graphics and Applications, IEEE. 14, 1 (1994), 30–39.
R20	Research Article	Bedri, A. et al. 2015. Toward Silent-Speech Control of Consumer Wearables. Computer. 48, 10 (Oct. 2015), 54–62.
R21	Research Article	Gemperle, F. et al. 2001. Design of a wearable tactile display. Wearable Computers, 2001. Proceedings. Fifth International Symposium on (2001), 5–12.
R22	Research Article	Feiner, S.K. 2002. Augmented reality: A new way of seeing. Scientific American. 286, 4 (2002), 48–55.
R23	Research Article	Mistry, P. and Maes, P. 2009. SixthSense: a wearable gestural interface. SIGGRAPH Sketches (2009), 11.
R24	Research Article	Sawhney, N. and Schmandt, C. 1998. Speaking and listening on the run: Design for wearable audio computing. Wearable Computers, 1998. Digest of Papers. Second International Symposium on (1998), 108–115.
R25	Research Article	Post, E.R. et al. 2000. E-broidery: Design and fabrication of textile-based computing. IBM Systems journal. 39, 3.4 (2000), 840–860.
R26	Research Article	Buechley, L. 2006. A construction kit for electronic textiles. Wearable Computers, 2006 10th IEEE International Symposium on (2006), 83–90.
R27	Research Article	Gilliland, S. et al. 2010. The Textile Interface Swatchbook: Creating graphical user interface-like widgets with conductive embroidery. Wearable Computers (ISWC), 2010 International Symposium on (2010), 1–8.
R28	Research Article	Rhodes, B.J. 1997. The wearable remembrance agent: A system for augmented memory. Personal Technologies. 1, 4 (Dec. 1997), 218–224.
R29	Research Article	Thorp, E.O. 1998. The invention of the first wearable computer. Wearable Computers, 1998. Digest of Papers. Second International Symposium on (1998), 4–8.
R30	Research Article	Berglund, M.E. et al. 2016. A Survey of the Historical Scope and Current Trends of Wearable Technology Applications. Proceedings of the 2016 ACM International Symposium on Wearable Computers (New York, NY, USA, 2016), 40–43.
R31	Research Article	Bush, V. 1945. As we may think. (1945).
R32	Research Article	Paradiso, J.A. 2006. Systems for human-powered mobile computing. Proceedings of the 43rd annual Design Automation Conference (2006), 645–650.
R33	Research Article	Starner, T. 1996. Human-powered wearable computing. IBM systems Journal. 35, 3.4 (1996), 618–629.
R34	Research Article	Choudhury, T. and Pentland, A. 2003. Sensing and modeling human networks using the sociometer. null (2003), 216.
R35	Research Article	Picard, R.W. and Healey, J. 1997. Affective wearables. Wearable Computers, 1997. Digest of Papers., First International Symposium on (1997), 90–97.
R36	Research Article	Post, E.R. et al. 1997. Intrabody buses for data and power. Digest of Papers. First International Symposium on Wearable Computers (Oct. 1997), 52–55.
R37	Research Article	Deyle, T. et al. 2007. Hambone: A bio-acoustic gesture interface. Wearable Computers, 2007 11th IEEE International Symposium on (2007), 3–10.
R38	Research Article	Harrison, C. et al. 2010. Skinput: appropriating the body as an input surface. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (2010), 453–462.
R39	Research Article	Laput, G. et al. 2016. ViBand: High-Fidelity Bio-Acoustic Sensing Using Commodity Smartwatch Accelerometers. Proceedings of the 29th Annual Symposium on User Interface Software and Technology (New York, NY, USA, 2016), 321–333.

R40	Research Article	Hinckley, K. et al. 2000. Sensing techniques for mobile interaction. Proc. UIST (2000), 91–100.
R41	Research Article	Iachello, G. and Hong, J. 2007. End-User Privacy in Human-Computer Interaction. Foundations and Trends® in Human-Computer Interaction. 1, 1 (2007), 1–137.
R42	Research Article	Langheinrich, M. 2001. Privacy by design—principles of privacy-aware ubiquitous systems. Ubicomp 2001: Ubiquitous Computing (2001), 273–291.
R43	Research Article	Profita, H.P. et al. 2013. Don't mind me touching my wrist: a case study of interacting with on-body technology in public. Proceedings of the 2013 International Symposium on Wearable Computers (2013), 89–96.
R44	Research Article	Komor, N. et al. 2009. Is it gropable?–assessing the impact of mobility on textile interfaces. Wearable Computers, 2009. ISWC'09. International Symposium on (2009), 71–74.
R45	Research Article	Picard, R.W. 2000. Toward computers that recognize and respond to user emotion. IBM systems journal. 39, 3.4 (2000), 705–719.
R46	Research Article	Starner, T. et al. 2000. The gesture pendant: A self-illuminating, wearable, infrared computer vision system for home automation control and medical monitoring. Proc. ISWC (2000), 87–94.
R47	Research Article	Bulling, A. et al. 2014. A tutorial on human activity recognition using body-worn inertial sensors. CSUR. 46, 3 (2014), 33.
R48	Research Article	Ward, J.A. et al. 2006. Activity Recognition of Assembly Tasks Using Body-Worn Microphones and Accelerometers. IEEE Transactions on Pattern Analysis and Machine Intelligence. 28, 10 (Oct. 2006), 1553–1567.
R49	Reference	Fraden, J. 2010. Handbook of modern sensors. Springer.
R50	Research Article	Azuma, R.T. 1997. A survey of augmented reality. Presence. 6, 4 (1997), 355–385.
R51	Internet Resource	Proceedings of ISWC, CHI, and UIST conferences