

Syllabus Overview

Course title: Principles of Wearable Technology

DES 3901.1

Spring 2023

MWF 1:55-2:45

online--remote/synchronous

3 credits

No final

Instructors: Dr. Brad Holschuh and Lucy Dunne

Office: 354 McNeal/356 McNeal

Office Hours: by appointment

Course Prerequisites: none

Course Information and Instructor's Expectations

Course Description:

Exploration of technologies, theories, and best practices for designing and developing systems incorporating wearable technology. This lecture-based class will introduce students to the physical principles that underlie many wearable technology subsystems, the ways in which those technologies have been developed by and for different stakeholder groups, and will discuss design approaches that conscientiously consider the broader implications for wearable technology, including a focus on user experience and wearability in systems design.

This course is an introductory course that focuses on wearable technology concepts blending User-Centered Design and sociocultural perspectives on wearable technology with Engineering Systems development. It is intended to be approachable for students with a wide variety of interests and backgrounds. Course material is explored through readings, lectures, discussions, and course projects. Optional laboratory course (DES.5902) provides hands-on opportunities to put these principles into practice.

DES 3901 Liberal Education requirement:

A guiding principle of this course is the liberal education perspective, in which innovation and its implications must be considered from a broad array of philosophical and practical standpoints. Through reading, classroom discussion, and critical course projects we will explore the relationship between wearable technologies and the important challenges facing individuals and groups in our world, as well as our ethical shared responsibility to understand and shape decisions that influence these relationships for future technologies. An additional weekly class meeting (Fridays) will provide the opportunity for DES 3901 students to delve more deeply into both technical and sociocultural aspects of each week's topic, including embodied experiences with hardware.

Required and Recommended Materials:

Required Text

None – readings will be distributed to class through the course website.

Recommended Texts

Hewitt, P. Conceptual Physics. Pearson (12th Edition), 2014.

Watkins, S. and Dunne, L. Functional Clothing Design. Fairchild Books (2nd Edition), 2015.

Student Learning Outcomes following course completion: (must identify at least one outcome and how it relates to this course how it will be addressed and how it will be assessed, <http://www.slo.umn.edu/>) This course meets the Liberal Education Technology and Society theme requirements. The following Student Learning Outcomes support these requirements by preparing students to critically evaluate both the technological functionality of a wearable device and the sociocultural forces that guided its development, as well as the implications of device design decisions for diverse stakeholder groups.

1. Students in this course will be able to identify, define and solve problems to satisfy human needs through the use of wearable technology systems. Learning will be assessed through evaluation of existing wearable technology products and systems, exams, and in-class discussions.
2. Students in this course will have mastered a body of knowledge and a mode of inquiry through critical evaluation of assigned readings, evaluation of existing wearable products and systems, and in class discussions. Learning will be assessed through evaluation of these critiques and design projects, exams, and through structured peer review.

Release of Work Statement:

Students understand that enrollment in this course grants consent for their work to be selected for inclusion in college or departmental publications (online or in print). Your instructor may select to use your work to represent her/his skills as an instructor in a teaching portfolio (online or in print).

Attendance:

Attendance is expected for all class sessions, and punctuality is essential. If you must miss a class session, you are responsible for arranging to make up any missed work and for all material and information covered in that class. You are expected to participate in class discussions and lab exercises, and be respectful and polite when critiquing classmates' work. The faculty reserve 10% of the final grade for class-participation, evaluated holistically based on student attendance and participation.

The following reasons justify absences and makeup requests and must be documented: (a) illness certified by the Boynton Health Service or another physician (b) death of parent, sibling, or grandparent (proof of funeral attendance must be supplied), (c) participation in religious observances with advance instructor notification (d) participation, certified by the Office for Student Affairs (Office of the Registrar-St. Paul, 190 Coffey Hall), in University approved co-curricular activities.

Workload:

Readings

Most weeks include an explicit reading assignment as well as self-directed project research reading. Assigned reading should be completed before the relevant lecture.

Conceptual Physics Exam

One take-home exam will be administered during the semester focusing on conceptual physics concepts relevant to wearable systems. The exam is aimed at reinforcing important concepts in the relevant lectures and textbook readings.

Weekly Comprehension Quizzes and Discussions

Each week the class time will be divided equally between a content lecture (55m) and small group discussion (55m) focusing on a reading assignment from that week. An online comprehension quiz will be administered after each lecture and must be completed within 24 hours to evaluate your understanding of the concepts taught in lecture that day. Small group discussions will center on applications and social issues related to the wearable technology topic at hand, starting in small group breakout sessions and culminating in a larger group discussion. A written deliverable is part of most breakout discussions.

Final Project

A final wearable technology project, focusing on a critical assessment (both technological and sociological factors) of a past or present wearable technology product, incorporating concepts taught in class. This project will be completed individually, culminating in a detailed final report (white paper) as well as a final presentation. Full details will be provided in the project assignment.

Grading Structure:

<http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html>

A grading rubric will be provided for each assignment, and will outline the criteria for evaluation for the specific assignment. If these criteria are not clear, it is your responsibility to ask for clarification. Your course grade will be calculated from your weighted project grades, as follows:

Participation and class exercises: 50% (25% comprehension quizzes, 25% discussion)

Conceptual Physics Exam:

20%

30%

Total 100%

The final grade – normalized to 100% -- is based on accumulated points divided by total points possible.

Grades are determined as follows:

A	93%	B	83%	C	73%	D	63%
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A-	90%	B-	80%	C-	70%	F	below 60%
B+	86%	C+	76%	D+	66%		

Accepting and Returning Assignments:

Most work will be submitted digitally, by email or through Canvas. Assignment comments are returned digitally or physically, depending on the assignment, and grades are posted on the course Canvas site.

Grading Late Work:

Assignments are due at the beginning of class specified in the syllabus, and will otherwise be considered late. Late work will be accepted at the beginning of the next class period, with a penalty of one letter grade. No work will be accepted more than one class period late.

Make Up Work for Legitimate Absences: <https://policy.umn.edu/education/makeupwork>

Extra Credit Options:

Extra credit options are rare, and will be announced in class if and when they arise.

University Policies

Personal Electronic Devices in Classroom:

Students may be directed to turn off personal electronic devices if the devices are not being used for class purposes. Students are not permitted to record any part of a class/lab/other session unless explicitly granted permission by the instructor. If the student does not comply, the student may be asked to leave the classroom.

Use of Class Notes and Materials:

Taking notes is a means of recording information but more importantly of personally absorbing and integrating the educational experience. However, broadly disseminating class notes beyond the classroom community or accepting compensation for taking and distributing classroom notes undermines instructor interests in their intellectual work product while not substantially furthering instructor and student interests in effective learning. Such actions violate shared norms and standards of the academic community.

Scholastic Dishonesty and Student Conduct Code:

You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis.

http://regents.umn.edu/sites/regents.umn.edu/files/policies/Student_Conduct_Code.pdf

Sexual Harassment: <https://policy.umn.edu/hr/sexualharassment>

Statement on Climate of Inclusivity:

You are expected to be attentive during class, ask questions if you do not understand something, and to offer your opinion. You are also expected to listen respectfully to other students and to me when speaking. The University of Minnesota is committed to providing a safe climate for all students, faculty, and staff. All persons shall have equal access to its programs and facilities without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation. Racism, sexism, homophobia, classism, ageism and other forms of bigotry are inappropriate to express in this class. Reports of harassment are taken seriously, and there are individuals and offices available for help.

Academic Freedom and Responsibility:

Academic freedom is a cornerstone of the University. Within the scope and content of the course as defined by the instructor, it includes the freedom to discuss relevant matters in the classroom and conduct relevant research. Along with this freedom comes responsibility. Students are encouraged to develop the capacity for critical judgment and to engage in a sustained and independent search for truth. Students are free to take reasoned exception to the views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled. When conducting research, pertinent institutional approvals must be obtained and the research must be consistent with University policies. Reports of concerns about academic freedom are taken seriously, and there are individuals and offices available for help.

Availability of Disability and Mental Health Services:

The University of Minnesota is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations. If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact DS at 612-626-1333 to arrange a confidential discussion regarding equitable access and reasonable accommodations. If you are registered with DS and have a current letter requesting reasonable accommodations, please contact your instructor as early in the semester as possible to discuss how the accommodations will be applied in the course. For more information, please see the DS website, <https://diversity.umn.edu/disability/>.

Academic Services:

If you would like additional help, please contact one of the offices listed below.

Wk. DES.3901 /5901

Monday Lecture (50m) DES.3901 /5901

Wednesday Discussion (50m) DES.3901

Friday Discussion (50 min) DES.3901/5901

Readings & Assignments

- 1 No Class (semester starts Tuesday 1/19) Introduction to Wearable Technology
Wearable Technology in the Liberal Education Curriculum (Dunne) History of wearable technology
Supplemental Readings
- 2 Conceptual Physics:
Circuits & Electricity (Holschuh) Conceptual Physics: Circuits &
Electricity (Holschuh) Conceptual Physics:
Circuits & Electricity Lecture:
Conceptual Physics Ch. 22-23 Supplemental Readings
- 3 Conceptual Physics:
Mechanics and Energy (Holschuh) Conceptual Physics:
Mechanics and Energy (Holschuh) Conceptual Physics:
Mechanics and Energy Lecture:
Conceptual Physics Chs. 4-8 Supplemental Readings
- 4 Conceptual Physics:
Thermodynamics and Heat Transfer (Holschuh) Conceptual Physics:
Thermodynamics and Heat Transfer (Holschuh) Conceptual Physics:
Thermodynamics and Heat Lecture:
Conceptual Physics Chs. 15-18 Supplemental Readings
- 5 Sensing: Mechanics
(Dunne) Discussion: Accuracy of step
counters, privacy in wearables Conceptual Physics review
(Holschuh) Supplementary
Readings
TAKE HOME EXAM GIVEN
- 6 Sensing: Biometrics
(Dunne) Discussion: Skin color
bias/error in biometric sensing Sensing technologies Supplementary
Readings
TAKE HOME EXAM DUE

7 Mechanical Actuation:

Rigid and Non-rigid robotics (Holschuh) Discussion: Ethics of wearable robots

Non-Mechanical Actuation: Haptics, Robotics technologies Supplementary Readings

8 Non-Mechanical

Actuation: Temperature, Optics (Holschuh) Discussion: VR, Wearables, and Hedonics VR/AR/MR technologies Supplementary Readings

9 Wearability, Fit, Comfort (Dunne)

Final Project Intro Discussion: Bias in sizing and fit

Human factors of wearability Supplementary

Readings Final Project Assigned

10 Usability and HCI

(Holschuh) Discussion: Accessibility and wearables Human interface technologies Supplementary

Readings

11 Information and data (Dunne) Discussion: Big data algorithms, ethics of ML Algorithms Supplementary Readings

12 NO CLASS – SPRING BREAK

13 Softgoods and Hardgoods Fabrication (Dunne) Discussion: Sustainability and environmental impacts of wearables Fabrication technologies Supplementary Readings

14 Consumer Adoption (Dunne) Discussion: social aspects of wearability Marketing approaches Supplementary Readings

15 Final Project work session/ Wrap-up topics Final project presentations part 1 Final
project presentations part 2 Final presentation slides Due

16 Final project

Presentations part 3 Final Report Due

FINALS PERIOD:

Final Project Presentations (if necessary) Saturday (5/8) -- 1:30-3:30pm

** Schedule subject to change, see Canvas for most recent version