HST.S49 Syllabus

Maker Lab: Affordable Care Solutions through Wellness Technologies and Patient-Generated Data

Staff
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Details
Session: Spring 2015
Time: W2-3, F2-4
Location: Lectures (W2-3) in E25-117, labs (F2-4) in MIT International Design Center N52-394
Credits: 12 U (1-2-9)
Website: http://hstmakerlab.org

Learning Objectives
KIT Students will understand how to make inclusive and hackable healthcare technologies through hands-on labs that invent health kits to catalyze patient ingenuity.

RELEVANCE / DATA Students will apply health kits to collect, visualize and transform data into meaningful healthcare information and insights.

IMPACT / COMMUNITIES Students will learn to document and share their solutions to transform pre-existing communities of patients and users into communities of makers to manage their own health.

Course Description
The disparities in affordable healthcare technology are a growing part of increasing healthcare costs in the U.S. and around the world. Students have shown a keen interest to use their skills in engineering and life science to develop affordable care solutions, largely in global health settings. This course aims to teach affordable prototyping and design strategies for health and medicine that can be applied in a) low resource settings, b) global health, and c) in the American healthcare system. Using Patient-Generated Data Devices as a learning model, students will design affordable devices that are used by patients to manage their health. Using Construction Sets for Health as a strategy, we will allow students to explore the rich diversity of possibilities that can be applied when patients are empowered to design their own solutions.
The course is a first in class approach at creating new health and wellness technologies buoyed by a specific set of drivers that we have identified:

The **Patient Empowerment Movement** led by examples such as Dave deBronkart, the Quantified Self Community, and online resources such as PatientsLikeMe have responded with evidence that recipients of health and wellness will not sit idly as healthcare is “applied” to them.

Emergence of Hardware Apps in health such as ThinkLabs stethoscopes, Adher.io and CellScope microscopes point to the ubiquity of smartphones as a catalyzing platform for health.

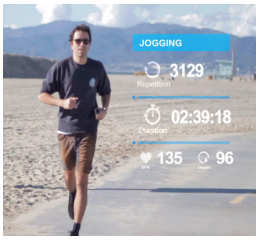
Consumerization of clinical devices is creating a shorter translational curve for health technology projects. Companies like FitBit have been successful in deploying healthcare devices within months of being founded due to their focus on consumer health.

Availability of medical fabrication is decreasing the costs of digital fabrication tools, such as 3-D printers, that ensure precision machining in healthcare devices and affordable, low-power embedded processors, and a community of practice around each area.

Availability of affordable and reliable sensors that can be used for physiological measurements by non-biomedical designers has opened the participation of non-traditional participants in health such as software programmers, the Maker movement, and environmental installation designers.

These drivers combined with our 4 design tracks create a platform for generating educational and entrepreneurial outcomes for students in a faster track than traditional biomedical device design. In each lab, students will participate in a team project in one of four tracks, supported by lectures. The 4 design tracks are:

- Casual
- Accessible
- Rural
- Home Care

CHALLENGE TRACKS	
Casual  The measure of wellness and performance health metrics through electronic as well wetlab trackers.	Accessible  Bridging the gap of wellness (e.g., nutritional markers), infectious disease (dengue, malaria), and health status diagnostics (diabetes, pregnancy) for patients with disabilities
Rural  Surgery, Trauma and First Aid The application of Construction Sets for Health aimed at areas with poor infrastructure brought out my isolation (rural areas), poverty, war or natural disaster. Focus on designing to leverage common problems in international cases as well as American healthcare settings to lower the cost of care.	Home Care  The application of health solutions for monitoring and providing care at home for populations that include neonates, seniors and patients with mental illness.

With each design lab, students are assigned on a rotating basis, one of the above tracks so they can design with different tools and also for different targets.

Curriculum

Date			Design Tracks			
			Casual	**Accessible**	**Rural**	**Home Care**
Feb 4	Lecture 1	Overview of course syllabus, including grading, time expectations Introduction to Maker Health				
Feb 6	Lab 1	Introduction to lab materials and digital fabrication. Lab training by Charles Guan	Foot stretching device for plantar fasciitis	Umbrella holder for a crutch user	Cell phone microscope holder	Pill bottle opener
Feb 11	Lecture 2	Construction Set Design Theory: Why do we need to make a kit? (YOUNG) Introduction to creating modular building blocks as a design strategy for user empowerment in health.				
Feb 13	Lab 2A	*(Presentation of Lab 1 devices*) Treatment devices and language of design: Kit design	Bike nebulizer	Modular prosthetic arm	Global health nebulizer	Remote monitoring of oral medication compliance
Feb 18	Lecture 3	Patient Generated Data (KEVIN PATRICK, UCSD)				
Feb 20	Lab 2B	*(Presentation of Lab 2A kits)* Treatment devices and language of design: Data generation	Bike nebulizer	Modular prosthetic arm	Global health nebulizer	Remote monitoring of oral medication compliance
Feb 25	Lecture 4	Point of Care Diagnostics: Assembly of paper microfluidics and point of care immunoassays and ligand conjugation (GEHRKE)				
Feb 27	Lab 3A	*(Presentation of Lab 2B data)* Use of lateral flow blocks and paper diagnostics: Introduction to mechanisms	Plug and play ebola diagnostics	Transforming output format for people with vision impairment	Plug and play ebola diagnostics	Vitamin D

Mar 4	Lecture 5	TBD (HADLEY SIKES/JIM COLLINS)				
Mar 6	Lab 3B	*(Presentation of Lab 3A kits - mechanisms)* Use of lateral flow blocks and paper diagnostics: Introduction to user interface	Plug and play ebola diagnostics	Transforming output format for people with vision impairment	Plug and play ebola diagnostics	Vitamin D
Mar 11	Lecture 6	Global Health (GOMEZ-MARQUEZ)				
Mar 13	Lab 3C	*(Presentation of Lab 3A kits - user interface)* Use of lateral flow blocks and paper diagnostics: Data generation	Plug and play ebola diagnostics	Transforming output format for people with vision impairment	Plug and play ebola diagnostics	Vitamin D
Mar 18	Lecture 7	App Inventor Learning Lab: Software construction set for mobile apps applied to health technology (HAL ABELSON)				
Mar 20	Lab 4A	*(Presentation of Lab 3C data)* App Inventor: Invent an app	DIY Smartphone Fitbit	First aid kit and NFC app for people with vision impairment	Epidemiology apps for global health diagnostics	Pharmacy navigator apps for seniors using NFC
Apr 1	Lecture 8	TBD (WILLIAM FREEMAN/JAKE CACCIAPAGLIA)				
Apr 3	Lab 4B	*(Presentation of Lab 4A apps)* App Inventor: Data generation	DIY Smartphone Fitbit	First aid kit and NFC app for people with vision impairment	Epidemiology apps for global health diagnostics	Pharmacy navigator apps for seniors using NFC
Apr 8	Lecture 9	Policy Implications of Patient Generated Data (JOHN HALAMKA, BIDMC CIO)				

Apr 10	Lab 5A	*(Presentation of Lab 4B data)* Creating sensorized health objects: Kit design	ECG accessories for bicycle handlebars	Detecting falls on users of orthoses	Affordable vaccine and diagnostic sample monitoring	Measuring forces on dog leashes
Apr 15	Lecture 10	IP and Open Source (ERIC VON HIPPEL)				
Apr 17	Lab 5B	*(Presentation of Lab 5A kits)* Creating sensorized health objects: Data generation	ECG accessories for bicycle handlebars	Detecting falls on users of orthoses	Affordable vaccine and diagnostic sample monitoring	Measuring forces on dog leashes
Apr 22	Lecture 11	Wellness Technology Landscape: Self trackers, smart scales and nutritional diagnostics and how they are embedded themselves into preventative medicine strategies. What are the implications for a digital divide in healthcare and how can we create designs that anticipate these challenges? (BRIAN TRACY/JOHN SCHIMMEL/ROB GOLDBERG)				
Apr 24	Lab 6A	*(Presentation of Lab 5B data)* Final project selection				
Apr 29	Lecture 12	Aesthetics and Accessibility: Why is aesthetics in medical device design important, and why is it often overlooked? What role does it play in medical compliance and social equity? (TEO)				
May 1	Lab 6B	Open studio: Work on final project				
May 6	Lecture 13	FDA and Regulatory environments (KIMBERLY ARMSTRONG)				
May 8	Lab 6C	Open studio: Work on final project				
May 13	Lecture 14	No lecture: Work on final project				
May 15		Final showcase of sensorized health objects and visualized data				

Grading policy

Item	**%**
Lab 1, 2, 3A, 3B, 4, 5 kit presentation	30
Lab 2, 3, 4, 5 data presentation	20
Final project and showcase	20
Peer feedback	10
Class participation	20

Kit presentations will be graded on:

1. Identification of core and modifier elements
2. Design language
3. Design for hack
4. Design for diffusion

Data visualization presentations will be graded on:

1. Quantity and quality of data collected
2. Clarity and attractiveness of data presentation
3. Meaningful use of data