

Assistive Technology for Opening Minds, Hands, and Hearts

Dr. Julie Greenberg, Dr. Kyle Keane,
Anna Musser, Jaya Narain, and
Pramoda Karnati



Please join us immediately after this talk for refreshments, and ATIC meet and greet, and the Mindful Sensorium Exploratorium (Please tell the community about the Accessible Technology Demo Day tomorrow April 18 1-4pm at the MIT Museum)

Intro

6.811/2.78/HST.420

Principles and Practices of Assistive Technology

3.008

Humanistic Co-design of Assistive Technology in the Developing World

ATHack

MIT's Student-Run Assistive Technology Hackathon

Student Perspective

Q&A



The Legacy of Seth Teller

- PPAT was previously taught by Professor Seth Teller, who brought the subject to MIT in 2011 and tragically passed away on July 1, 2014.
- We are proud to continue Professor Teller's efforts through the continuation of 6.811/2.78/HST.420.
- Both ATHack and 3.008 owe their inspiration to the passion and commitment of Seth Teller who serves as a beacon of hope for those looking to bridge their technical skills with a passion for service and impact.
- To honor his memory, MIT has created the [Seth Teller Memorial Fund to Advance Technology For People With Disabilities](#), which will support research, education, and other innovations that advance and improve assistive technology for people with a range of disabilities.

Disability – Dimensions

According to the World Health Organization, disability has three dimensions:

- **Impairment** in a person's body structure or function, or mental functioning; examples of impairments include loss of a limb, loss of vision or memory loss.
- **Activity limitation**, such as difficulty seeing, hearing, walking, or problem solving.
- **Participation restrictions** in normal daily activities, such as working, engaging in social and recreational activities, and obtaining health care and preventive services.

Disability – Impairment

There are many types of disabilities, such as those that affect a person's:

- Vision
- Movement
- Thinking
- Remembering
- Learning
- Communicating
- Hearing
- Mental health
- Social relationships



Disability – A Broader View

- **Permanent** – a condition that has no prognosis for improvement with any known medical or technological intervention
 - Missing limb, malfunctioning of muscular or skeletal apparatus, death of retina, developmental delays, etc
 - Can be progressive, static, or intermittent
- **Temporary** – a condition that has a prognosis for complete improvement or cure through medical or technological intervention
 - Cataracts, myopia, hyperopia, broken arm, exhaustion, heat stroke, etc
- **Contextual** – a condition affecting someone only within a certain context, situation, or circumstance
 - Parent carrying their baby, person walking while looking at their phone or listening to headphones (or both), person on a loud subway, etc

Disability – Variations and Adaptation

Commonly disability is thought of as something binary and inherent to a person, it is in fact a more nuanced human experience

- Although “people with disabilities” sometimes refers to a single population, but more often this is actually a diverse group of people with a wide range of needs.
 - Two people with the same type of disability can be affected in very different ways.
 - Some disabilities may be hidden or not easy to see.
- Activities and participation can be made easier or more difficult as a result of environmental factors, such as technology, support and relationships, services, policies, or the beliefs of others.
- Adaptation, innovation, and resiliency on the part of individual and society play a key role in the rehabilitation and inclusion of people with disabilities.

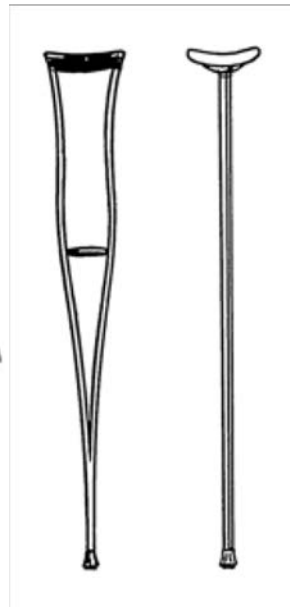
Assistive Technology

- **What is assistive technology?**

“Assistive Technology (AT) is any item, piece of equipment, software program, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities.” – Wikipedia

- **Examples:**

- Wheelchairs
- Eyeglasses
- Crutches
- Screen Readers
- White Canes



Accessibility

- **What is accessibility?**

“The concept of accessible design and practice of accessible development ensures both ‘direct access’ (i.e. unassisted) and ‘indirect access’ meaning compatibility with a person’s assistive technology”
– Wikipedia



- **Examples**

- Access Ramps
- Curb-cuts
- Semantic HTML
- Captioning

```
10 <table width="100%">
11 <tr>
12 <td>This</td>
13 <td>is</td>
14 </tr>
15 <tr>
16 <td>bad</td>
17 <td>layout?</td>
18 </tr>
19 </table>
```

```
21 <div class="container-fluid">
22 <div class="row">
23 <div class="col-md-6">But</div>
24 <div class="col-md-6">this</div>
25 </div>
26 <div class="row">
27 <div class="col-md-6">is</div>
28 <div class="col-md-6">ok?</div>
29 </div>
30 </div>
```


Universal Design

- **What is Universal Design?**

“The concept of designing all products and the built environment to be aesthetic and usable to the greatest extent possible by everyone, regardless of their age, ability, or status in life” – Ronald Mace


- **Examples:**

- Bop-it
- Bradley Watch
- Bone Conduction
- Cuteness



The Bradley Timepiece. Tell time by touch or sight.

AT @ the Frontiers



Seeing AI 4+
Talking Camera for the Blind
Microsoft Corporation
★★★★★ 117 Ratings
Free

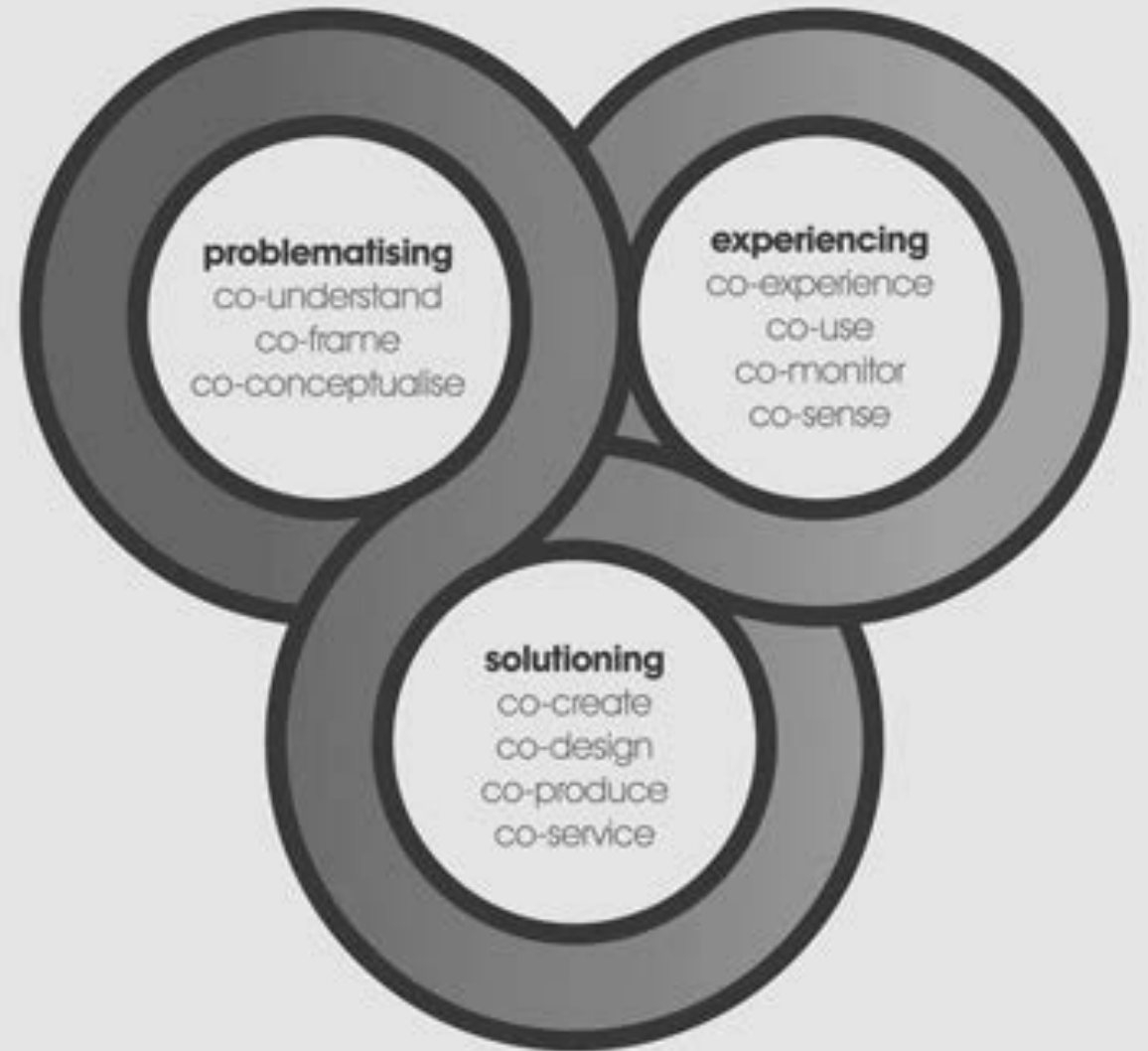


Co-design

- Also known as
 - Participatory Design
 - Collaborative Design
 - Co-production
 - Co-creation
 - ...
- Means
 - To design jointly with stakeholders
- Quote

• “We believe in the power of co-creation: innovation by and with communities is more effective than innovation for communities. Developing capacity for innovation is critical to improve a community’s access to food, water, energy, and health.”

- <http://www.idin.org/about-idin>



Intro: Humanistic Co-design

Listen first...

Learn about the dreams and aspirations...

hear the frustrations and ambitions...

then co-design

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PPAT: Principles and Practice of Assistive Technology

Project-based class in which teams of students work closely with a person with a disability in the Boston/Cambridge area to develop an assistive technology that helps them live more independently.



PPAT: Learning Goals

- Understand principles and complexities of assistive technology design and engineering.
- Learn about the challenges and realities of people with disabilities and become equipped as an advocate.
- Gain experience managing a team-based design/engineering project and working with a real client.

PPAT: Classroom Activities

- Assistive Technology Showcase
- Wheelchair Lab
- Panel: Interacting with Persons with Disabilities
- Panel: Students with Disabilities
- Aesthetics of Assistive Technology Design
- Scaling Up - Post-PPAT Opportunities
- Adaptive Outdoor Adventures <http://www.waypointadventure.org>



WAYPOINT



ADVENTURE

PPAT: Project

- Range of technologies
- Weekly client meetings
- Problem definition
- Exploration of existing solutions
- Iterative prototyping
- Success metrics and user testing
- Video documentation
- Technical documentation



PPAT: Logistics

- Listed in EECS, Mech E, HST – 6.811, 2.78, HST.420
- Undergraduates
- Fall term, 12 units
- <http://ppat.mit.edu>
 - Past projects – videos and final project documentation

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MIT INDIA



**Interactive Materials
Education Laboratory**

3.008: Humanistic Co-Design of Assistive Technology in the Developing World

January 2019 - India



Agra

- Top left: Bhangra moves in front of the Taj Mahal
- Top middle: Friendship captured inside the grounds of the Taj Mahal
- Top right: Arches within the Red Fort
- Bottom: Waiting to get into the Taj Mahal



SmartCane™ Device

Electronic Mobility Aid

The 'SmartCane' device is an affordable obstacle detection system that is mounted on the white cane carried by the visually challenged.



OnBoard™

Bus Identification System

OnBoard allows users to identify the route number of buses approaching a bus stop.



TacRead

Tactile Readout Device

TacRead is a device that enables people with visually impairment to read digital text through tactile interface.

IIT Delhi – AssisTech Lab
Led by Professor PVM Rao



Indian Spinal Injuries Center

MIT and IIT Delhi students and staff gather outside of the Indian Spinal Injuries Center after observing patients and interviewing clinicians.

IIT Delhi

Abhishek helping his group construct a handle that provides multiple grip options for people with visual impairments that use canes.



IIT Delhi

A group of MIT and IIT Delhi students proudly showing their prototype of an electronic balancing board that gives real time feedback that could aid in the recovery of certain spinal injuries.



MIT Professor Pawan Sinha explaining what mechanisms might further improve health outcomes for blind children who undergo cataracts surgery.

Project Prakash





Project Prakash

Children recovering
from their cataracts
surgery coming to
greet the MIT class.



Project Prakash

Pramoda enjoying the company of two young girls who can now see as the result of their cataracts surgery.



Project Prakash

Prakash researchers, clinicians, aid workers, children and their parents join our MIT class for a photo after lunch.



Delhi – MIT Alumni

MIT alumni from India treat us to some home cooked food and hospitality.



Old Delhi

Exploring the Jama Masjid mosque.



Old Delhi

Students explore Old Delhi on a rickshaw tour of the city.



Chennai

Dr. Kyle Keane explaining the co-design process to a small group of Indian undergraduate students and engineers.

Chennai

Students simulate having various challenges during the Exploratorium.

Top: students explore visual challenges with canes

Bottom left: students explore mobility challenges with wheelchairs

Bottom middle: students explore dexterity challenges with oven mitts

Bottom right: students explore challenges with screen readers





A co-designer with a visual impairment explains his idea for making more apps and websites compatible with screen readers.

Chennai



Chennai

Celebrating our co-designers with a gift and the Indian Sign Language sign for applause.



A group shares their idea for a device that can translate sign language into spoken word using EMG

Chennai

Chennai

- Students explore Chennai
- Top left: Getting ready for an Indian wedding
- Bottom left: Grabbing a bite with new friends
- Top right: Enjoying the beach
- Middle right: Making new friends and playing new games
- Bottom right: Getting henna



Chennai

- Top left: St. Mary's Catholic Church
- Top right: Kapaleeshwara Hindu Temple
- Bottom: Garden of Fort St. George





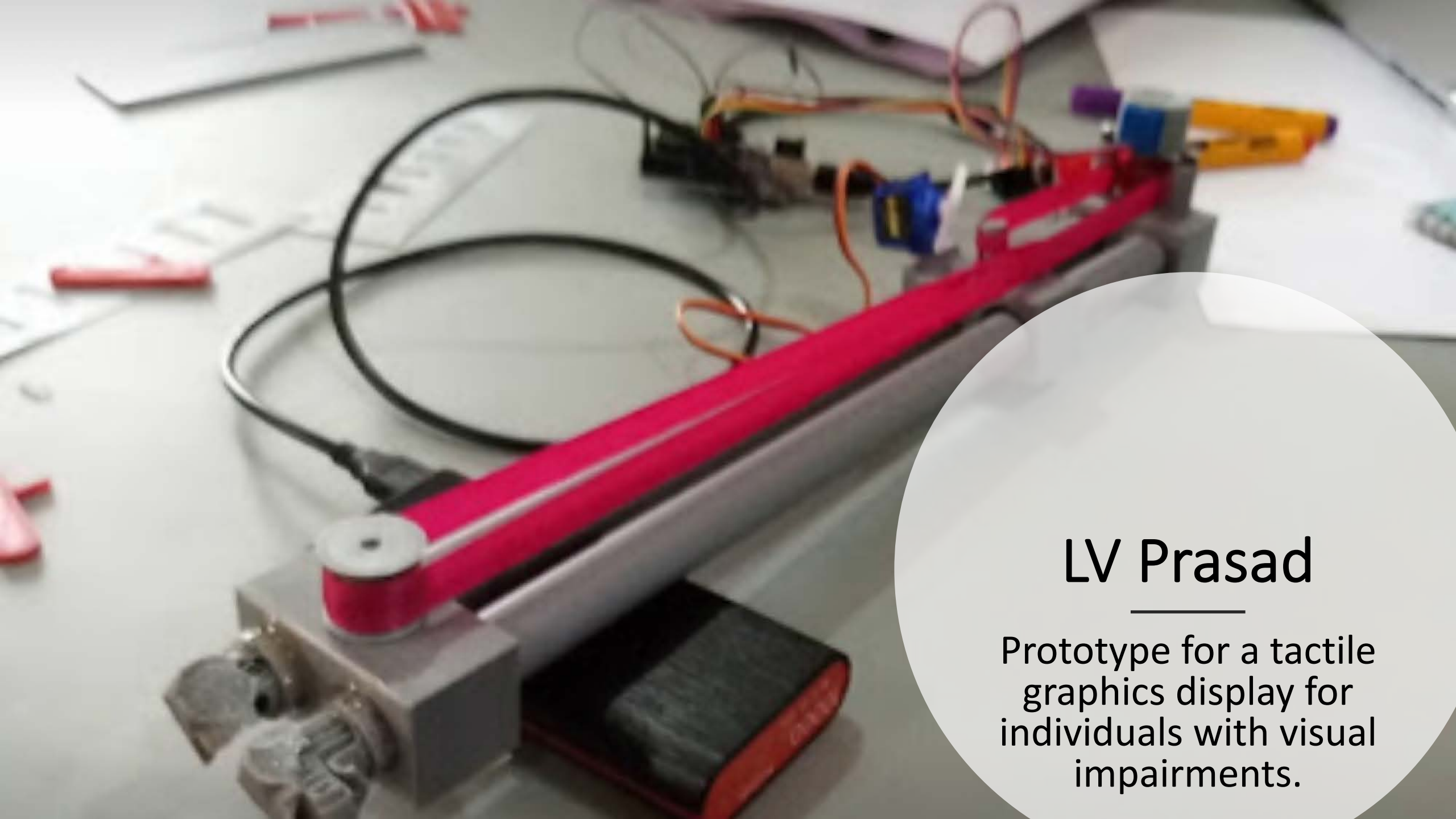
LV Prasad

Co-designers with visual impairments and MIT students form groups to start their collaboration.



LV Prasad

Pramoda goes on a home visit with an aid worker at LV Prasad.



LV Prasad

Prototype for a tactile graphics display for individuals with visual impairments.

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ATHack 2019 Team



Jaya Narain



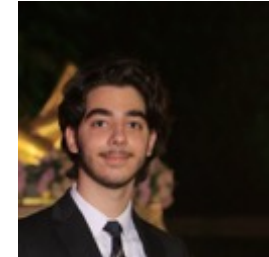
Ishwarya
Ananthabhotla



Hosea Siu



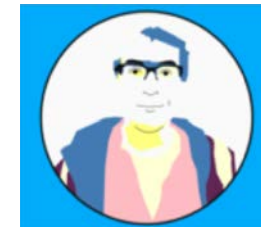
Sally Beirut



Tareq
El Dandachi



Imane Bouzit



Sam Mendez



Amanda Fike

Our Mission

Our mission is to make the world more **accessible to everyone** by building connections within our community and fostering **collaborative efforts** to create **inclusive technology**. Through ATHack, we introduce students to the fun (and challenging) design space of assistive technology while **building connections** between community members, engineers, and designers. We hope to inspire participants to pursue projects in the AT space in the future.

Program Goals

- Introduce students to the fun (and challenging) design space of assistive technology
- Build connections between community members, engineers, and designers
- Inspire participants to pursue projects in the AT space in the future



Program Reach



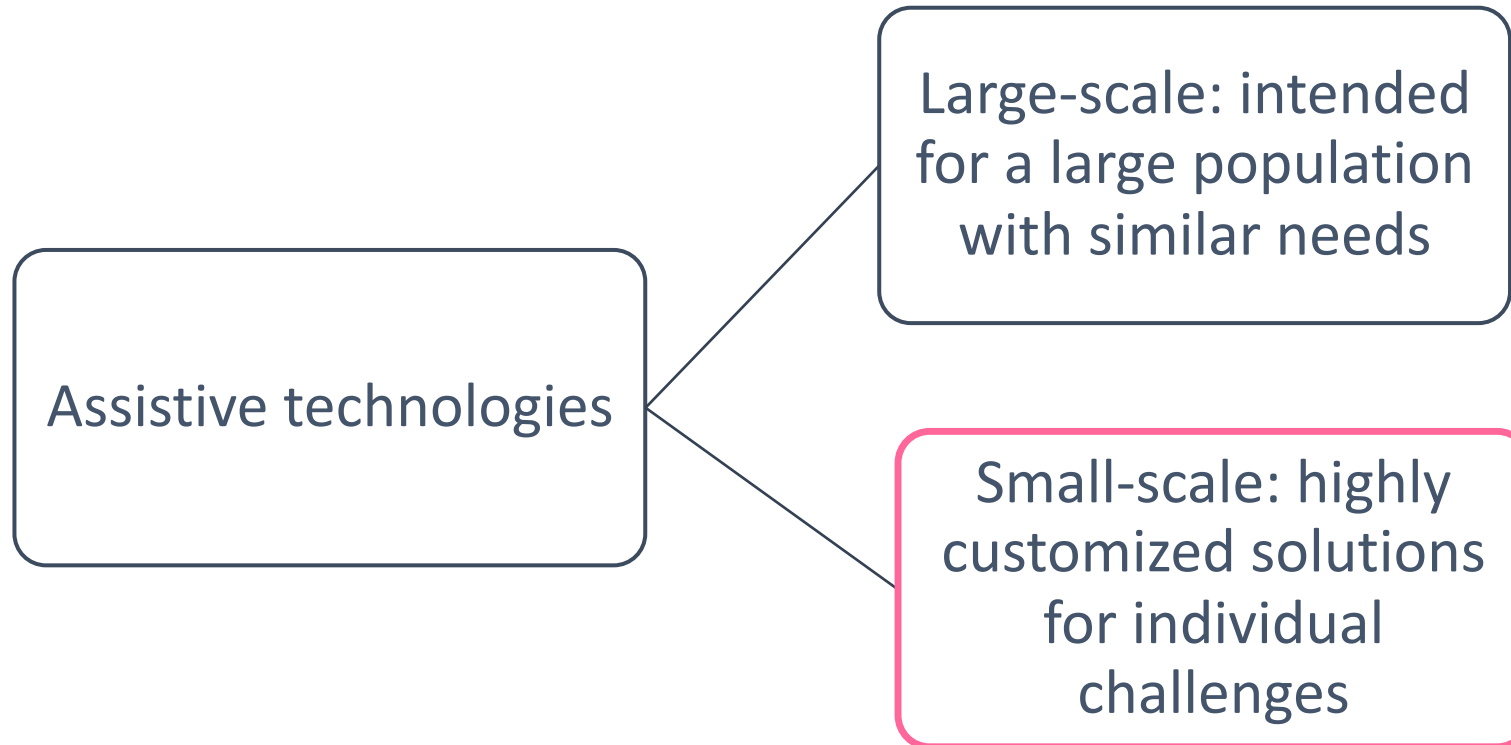
Over the course of **6 hackathons**, over **400 hackers** have worked on 80 projects for more than **75 community co-designers**

Our program emphasizes collaborative development: **students** and co-designers work together on AT projects

- Successful technologies cannot be created in isolation from their use context
- In the realm of assistive technologies, end users (**co-designers**) have particularly unique experiences and knowledge



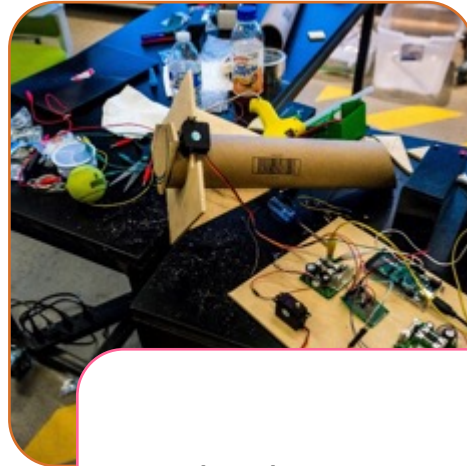
A focus on small-scale projects



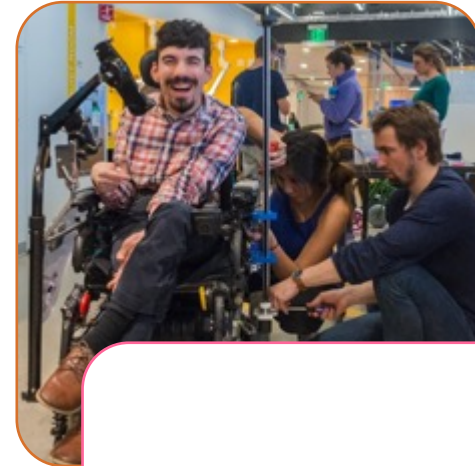
The hackathon process



Meet the Co-Designers Dinner
(Two weeks before hackathon)



Hackathon teams begin designing and order materials



All day hackathon!

A peek into ATHack 2017...



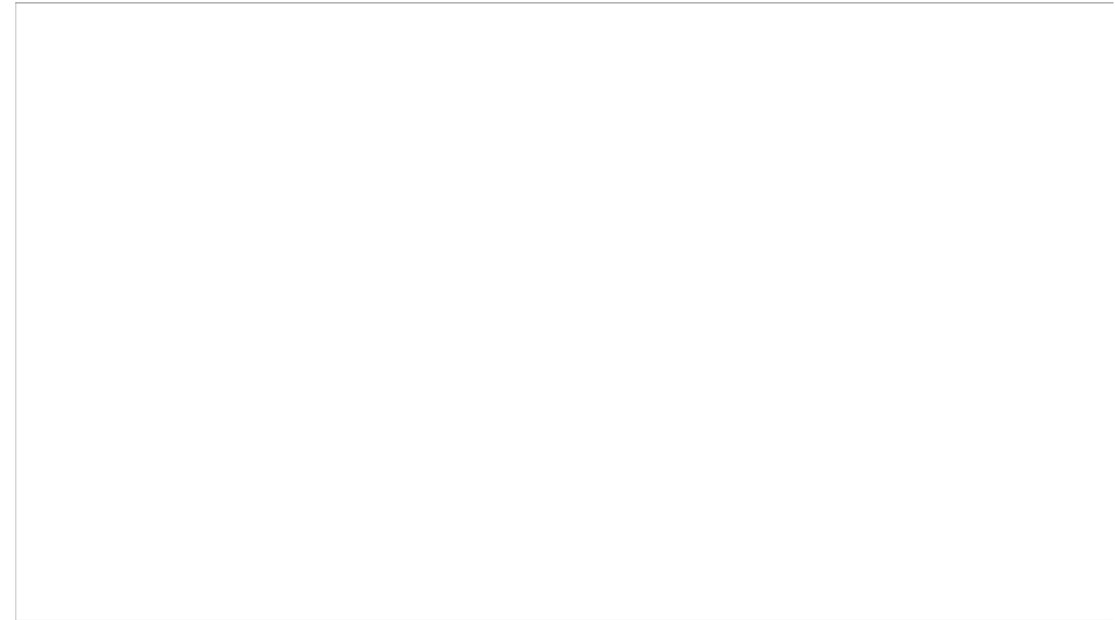
Video by John Freidah



ATHack 2019: Team Lora



ATHack 2019: Team Alex



Video Sam Mendez

ATHack 2019: Team Sarah



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PPAT Fall 2018

Team Ashley

Final PPAT Video

<https://www.youtube.com/watch?v=mgljoRnQZrA>





3.008

India 2019



ATHack

Team Susan

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