Paper Mechatronics: Creating High-Low Tech Design Kits to Promote Engineering Education

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Paper Mechatronics
R & D TEAM:

Lawrence Hall of Science at UC Berkeley

Univ. of Colorado at Boulder - Craft Technology Lab

Challenges

- Learning is teacher-driven rather than interest-driven and learner-centered
- Current learning materials have limited adaptability, expressivity, and accessibility
- Robotics kits are too expensive for most families
- The culture of robotics favors competition vs. other ways to participate in engineering

How do we broaden participation so all kids can learn engineering (robotics & mechatronics)?

Paper Mechatronics

Mechatronics

- Design of Microprocessor-based Mechanical Systems
- Real-time computing
- Electromechanical components
- Feedback, control fundamentals
- Architecture of microprocessors
- Concepts of time in computing engr
- Programming

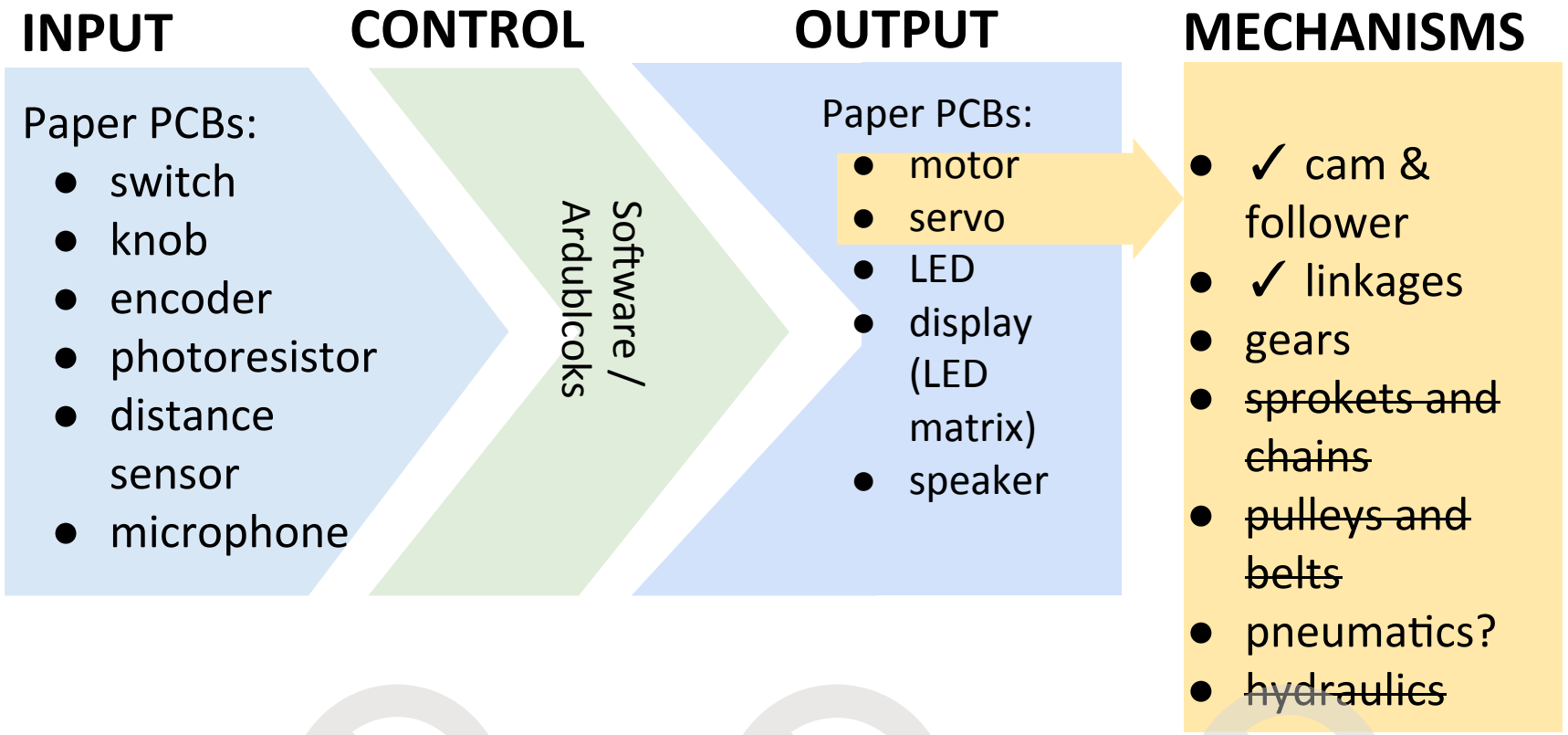
Craft Making

- Inviting
- Interest-driven
- Learner-centered
- Hands-on
- Joyful
- Expressive
- Materials-rich

Why paper?

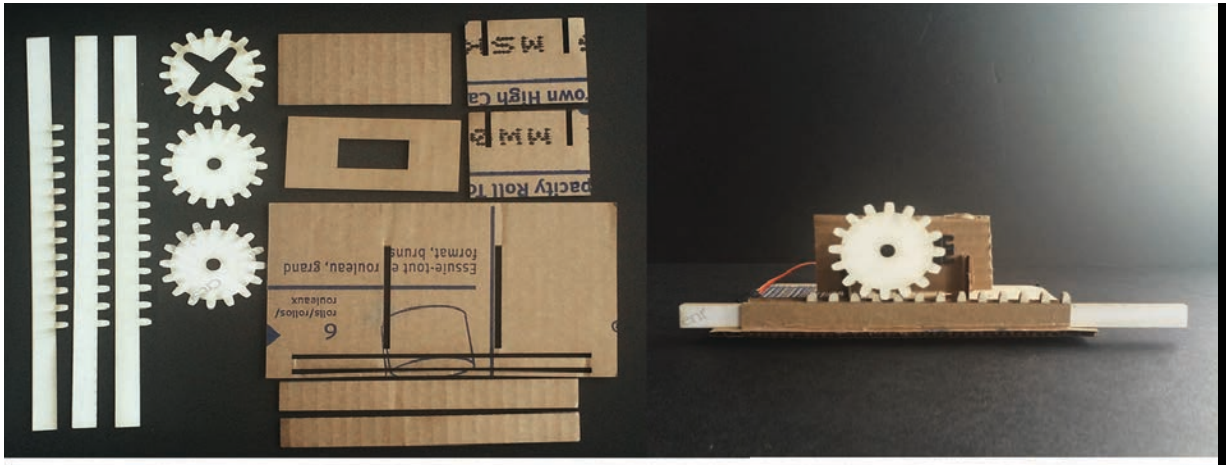
- Ubiquitous in most homes, schools, cafeterias
- Papercrafts are joyful and familiar (origami, airplanes, paper dolls, …)
- Easy adaptable, cut, shaped, formed
- Layering with expressive materials like paint, glitter
- Recycable, compostable

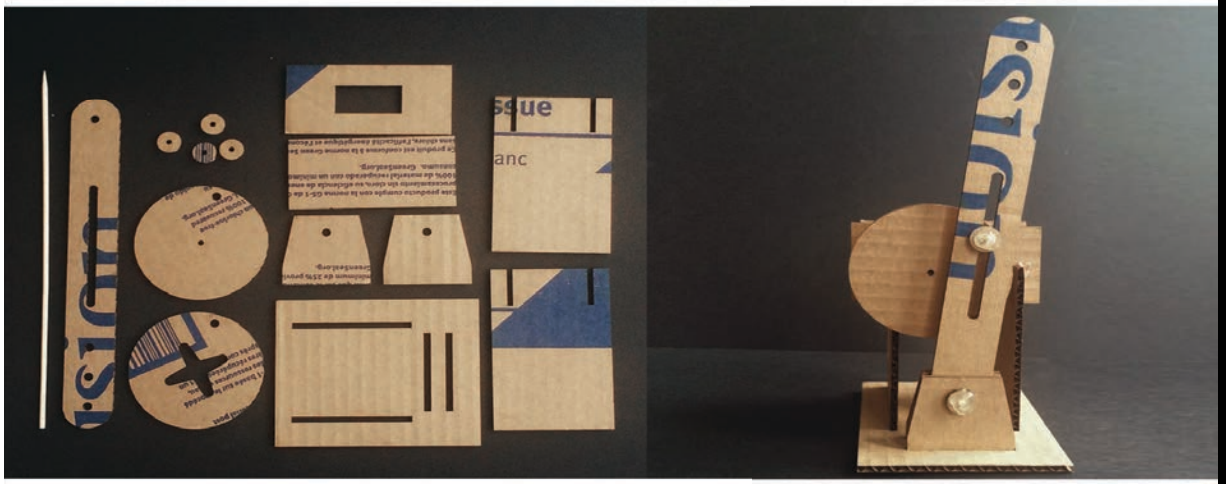
Draft Design Framework

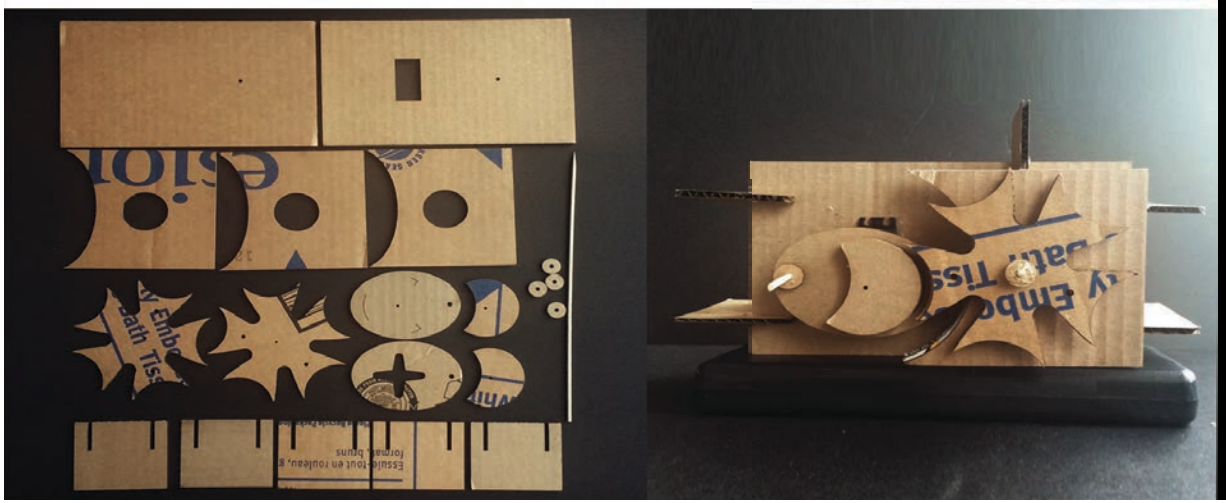


Avoid: **Breadboarding** **Syntax** **Tight Tolerances**

Aim for: **Low-Cost** **Common Tools or Digifab Tools** **Paper-based materials**







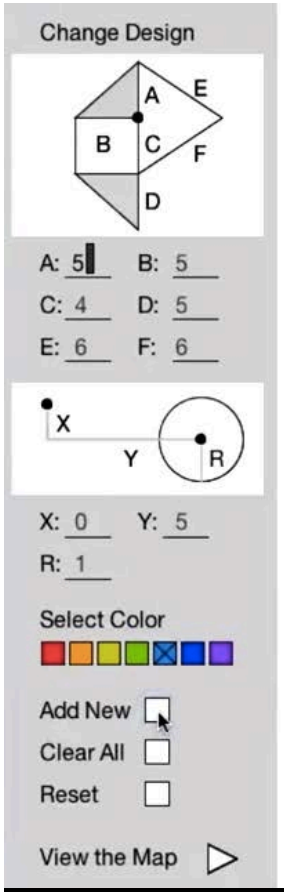
Laser-cut components

Classical Mechanisms

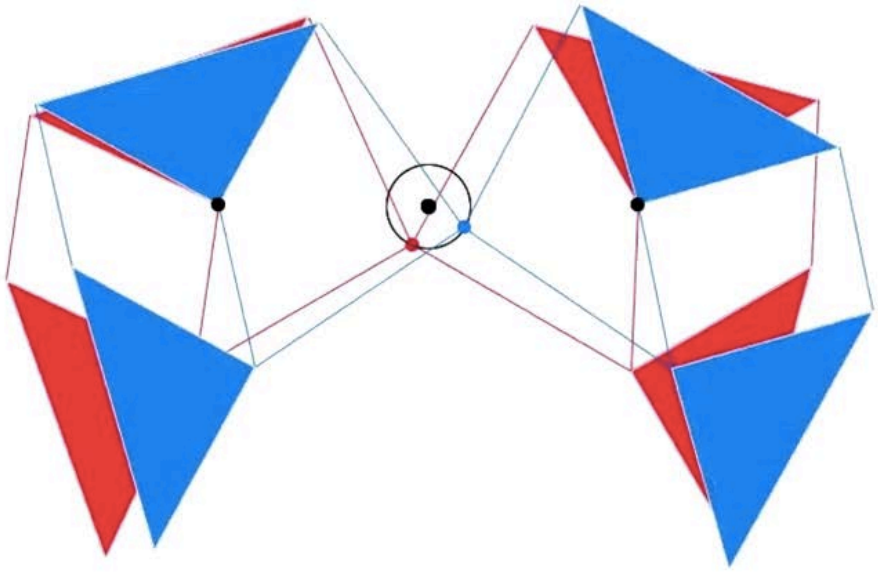
Computer-controlled

Work of Graduate Students:

- HyunJoo Oh
- Abhishek Narula
- Jiffer Harriman

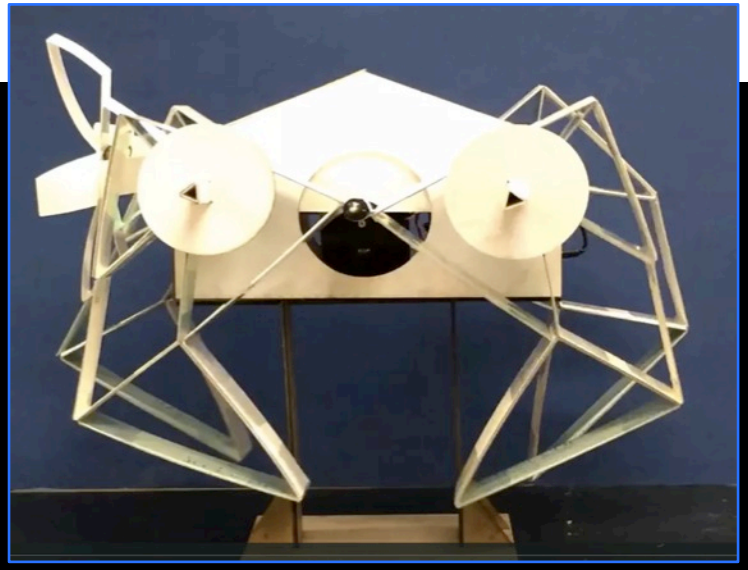


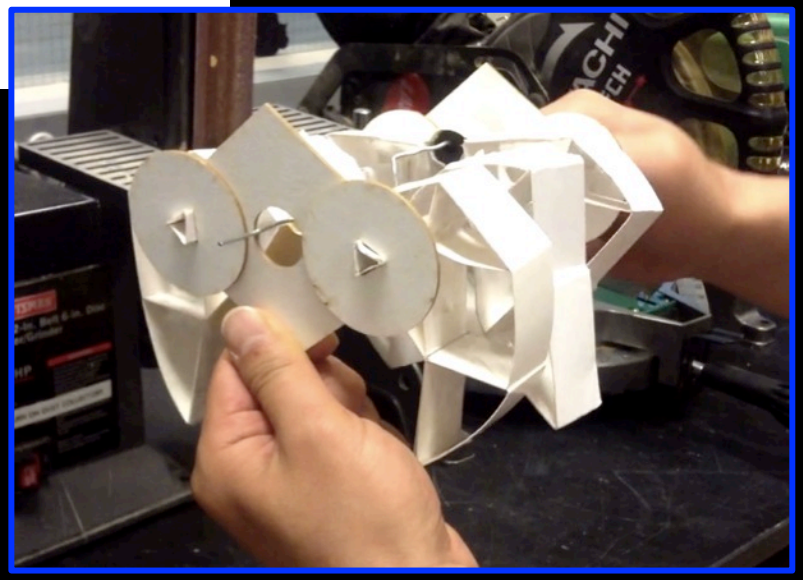
Fall 2014



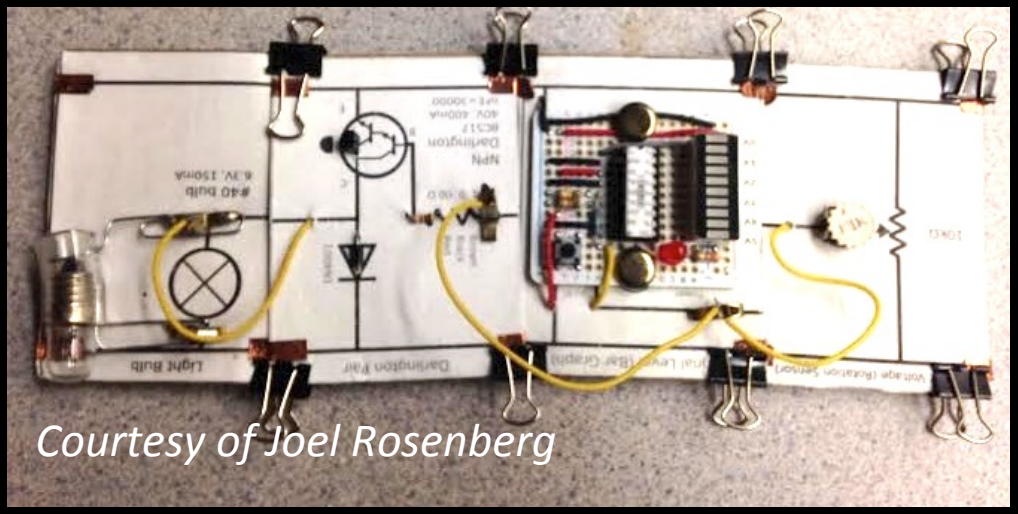
Motion modeling software for paper components

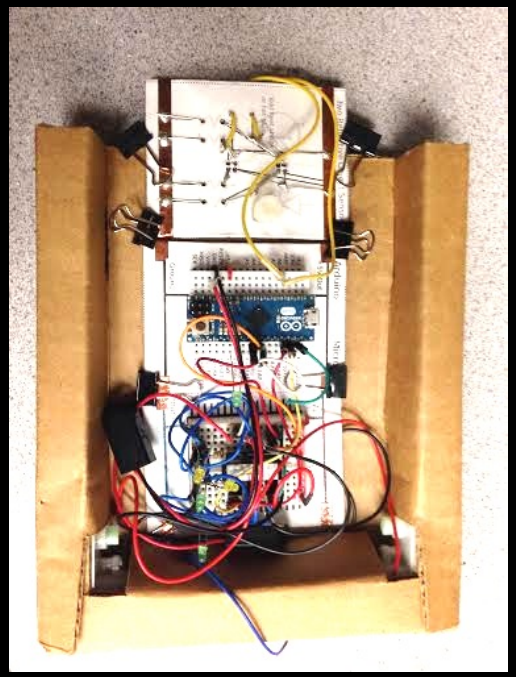
Hyun Joo Oh,
Mike Eisenberg,
Mark Gross,
CU Boulder





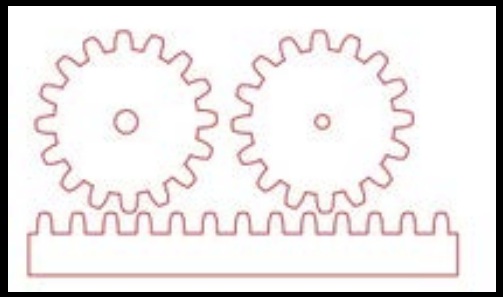
Cardboard sub-components

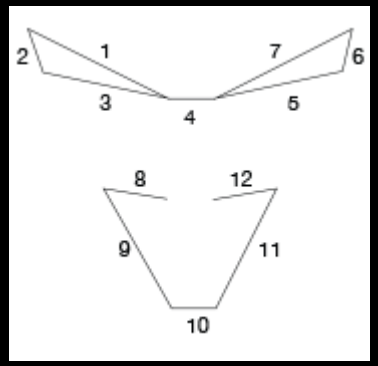




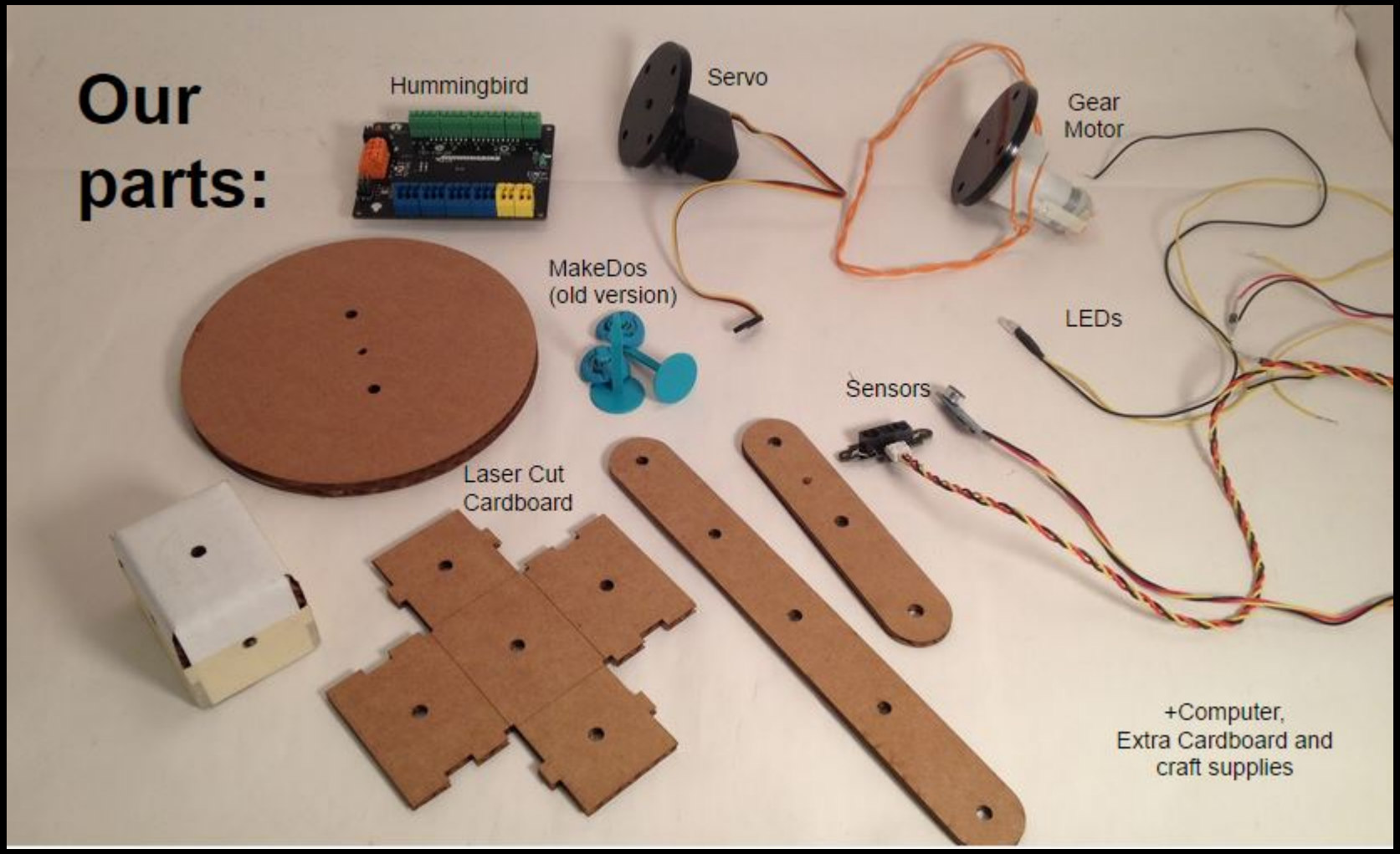
Tracing Bot

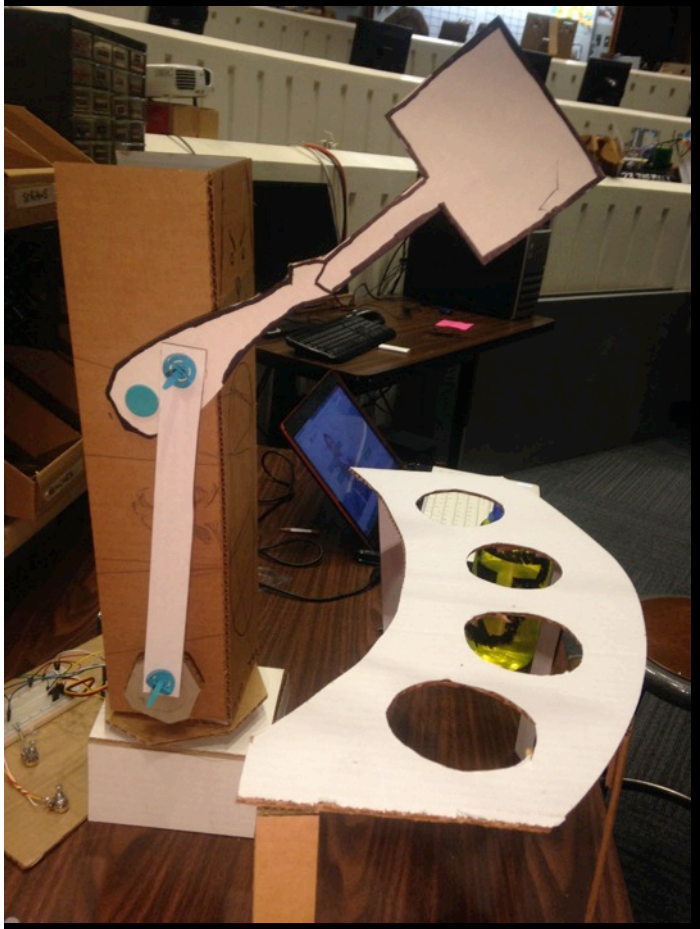
Digital design templates

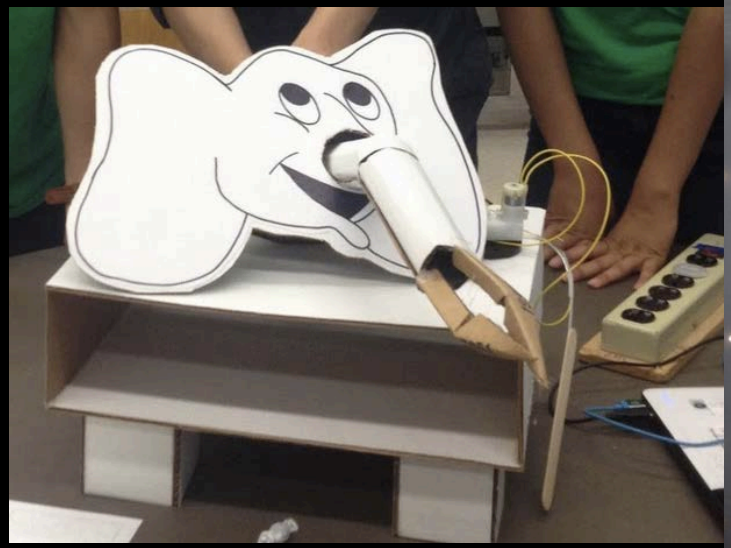




Kits and Boards







THE LAWRENCE HALL OF SCIENCE

TechHive

Design Studies

- Paper Flower Garden ("Tiki Room")
- Cereal Box Hackathon
- Robot Theaters
- Hackathon - Robot Petting Zoo
- High school physics – RPZ
- Percussive Instruments Workshop


Children's Creativity Museum
Robot Petting Zoo

Activation Dimension	Pre	Post	Mean Difference	paired t-test result
fascination	3.41	3.73	0.32	0.002
values	3.08	3.31	0.23	0.001
competency belief	3.05	3.33	0.28	0.004
innovation stance	3.06	3.47	0.41	0.000

Participants demonstrate a statistically significant increase in their levels of fascination, value, competency belief, and innovation stance from pre-survey to post-survey.

Robot Petting Zoo

Lighthouse Charter School Oakland

We envision an expressive, technology-enhanced medium be designed to enable all learners to learn mechatronics while creating what they imagine using the affordances of paper.

From Papercrafts to Paper Mechatronics

Sherry Hsi, UC Berkeley
Mike Eisenberg, CU Boulder

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