Robot Diaries

Broadening Participation in the Computer Science Pipeline through Social Technical Exploration

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Robot Diaries

Motivation: Increase participation of middle school girls in science and technology activities and studies

Method: Include girls in participatory design workshops to discover compelling technology experiences

Learning Goals: Improved motivation and confidence, technical knowledge, design skills

Why Girls?

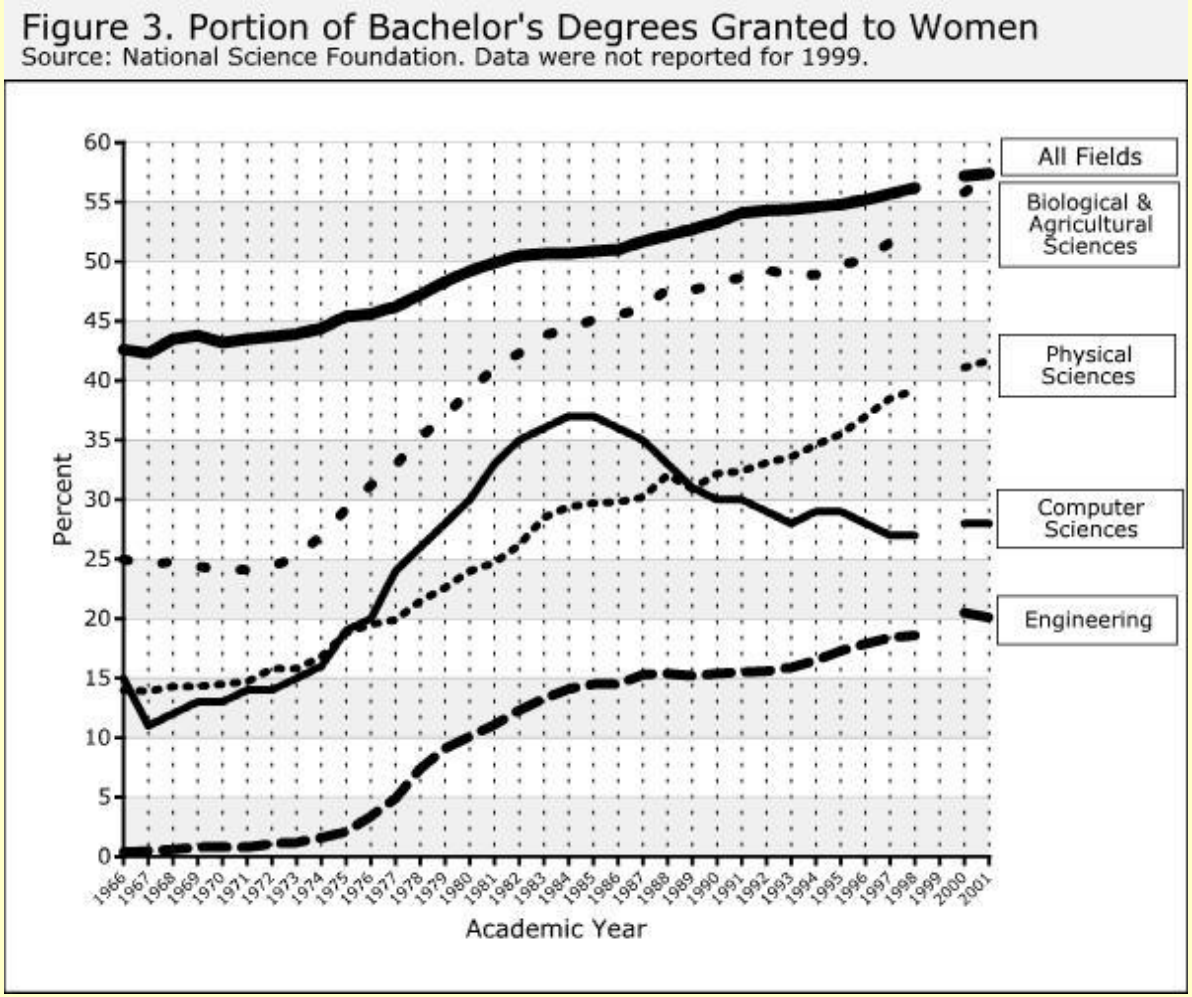


Figure 3. Portion of Bachelor's Degrees Granted to Women
Source: National Science Foundation. Data were not reported for 1999.
Percent
Academic Year
All Fields
Biological & Agricultural Sciences
Physical Sciences
Computer Sciences
Engineering

Why Middle School?

- Girls and women drop out of technology education in greater proportions to men at every level, *starting at middle school.*
- Drop out linked to diverging levels of confidence in use of technology at the start of adolescence.
- Students may use technology differently.

Schoenberg, 2001; Fredrics and Eccles, 2002

Existing Robotics Programs

- FIRST LEGO League, BEST and Botball
  - Competitions
  - Large, intense
  - Male dominated

Not for Everyone

- “She has been fascinated by robotics for a long time… every time we sign up for one of those [technology] camps…, we’ll get there on the first day and it’s all obnoxious little boys and she just goes, ‘never mind.’… Every time we get a thing in the mail, she looks and sees if there’s a robotics one and then she chickens out cause it just doesn’t, you know, she feels like she’s going to be the only girl.” – *parent*

- “It [First team] was so incredibly boring and we couldn’t do anything because it was drag and drop Legos so we dropped out and it was really boring.” – *child*

Emerging Robotics Programs

- Artbotics
  - UMass Lowell
  - Robotic art exhibits
- Cricket
  - MIT
  - Musical sculpture, jewelry, dancing creatures
- LilyPad Arduino
  - University of Colorado
  - Wearable electronics

Initial Idea

- Robots + Diaries
- Program robots to express emotion of diary entry
- Share robot expressions, private diary text

- Focus group reactions
  - Don’t keep diaries
  - “*SPA, Stupid Pointless Appliance*”
  - Liked zoomorphic forms
  - Liked emotional expression

Approach

- Hold participatory design workshops to develop the right technology experience

- Participatory Design:
  - Involve end-users in the design process
  - Continual feedback at all stages of design process
  - Participating end-users develop ownership over the designed product

2006 Workshops

- Summer Participatory Design Workshop
  - 6 sessions, 7 girls
- Single-Day Workshops
  - 2 days, 27 girls
- Fall Participatory Design Workshop
  - 9 sessions, 8 girls

Summer Workshop Series

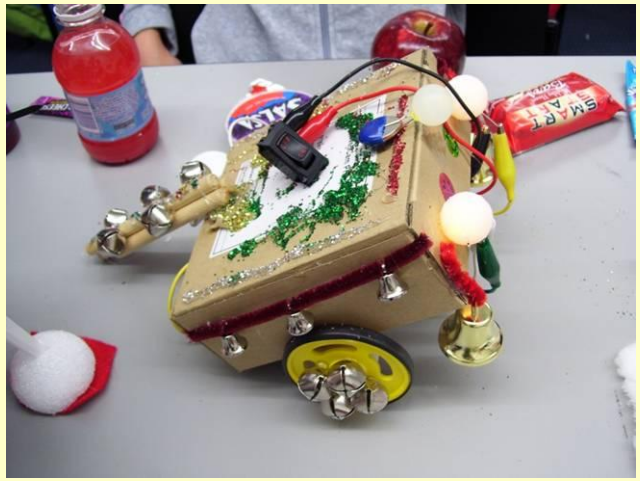
- Questions
  - What type of robot do middle school girls want to create?
  - What are fun activities to introduce technology to girls?
- Results
  - Expressive, communication-based robots
  - Set of curriculum activities
    - Light show with LEDs
    - Perform a dance or story
  - Other: materials at hand; timing (4x)

New Idea

- Robots + Messaging
- Emotional expression
- Communication – messages, games, story telling
- Implications of messaging
  - Networked
  - Take home
  - Similarity between designs so that expressions transfer

Single-Day Workshops

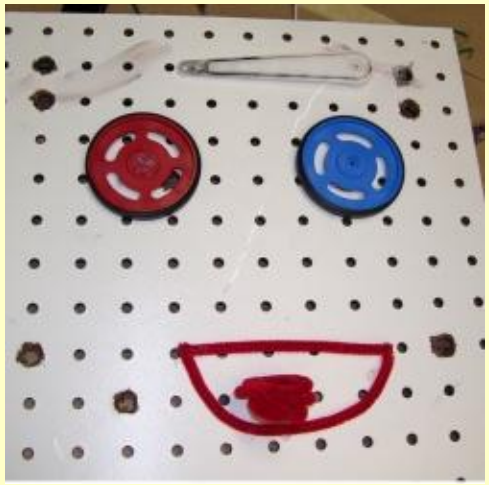
- Questions
  - Will more girls enjoy making expressive robots?
- Results
  - Yes

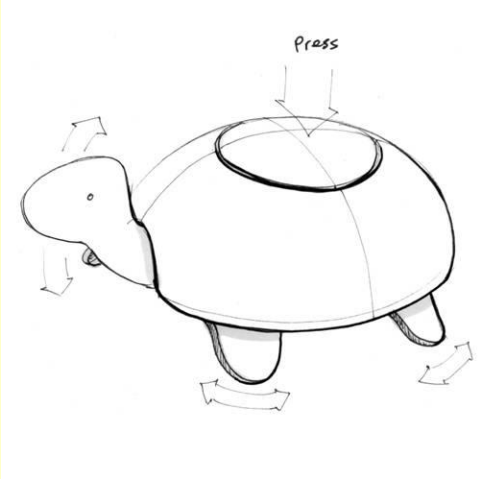


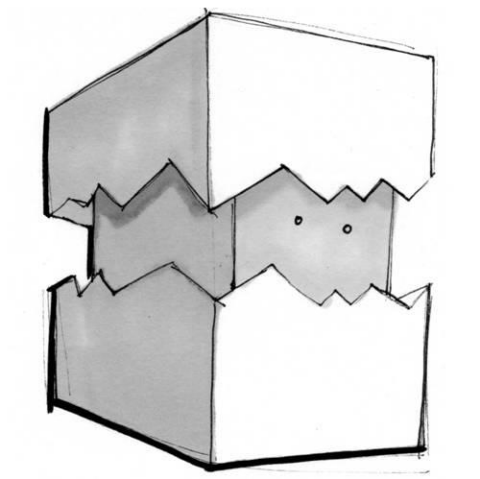
Fall Workshop Series

- Questions
  - What should an expressive robot look like (materials and basic form)?
  - How does the workshop affect girls' knowledge, engagement, and confidence with technology?

Materials and Form







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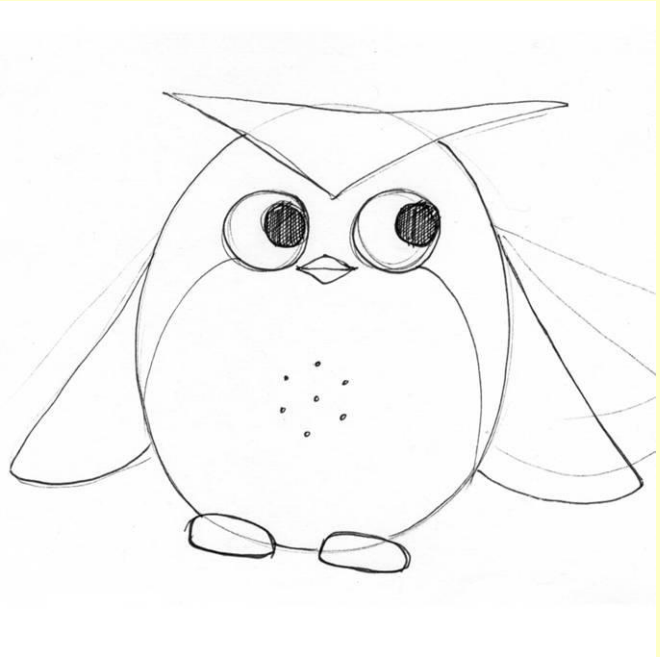


- Flat, foam board body
- Servos move arms
- Colored LEDs in eyes

Materials and Form







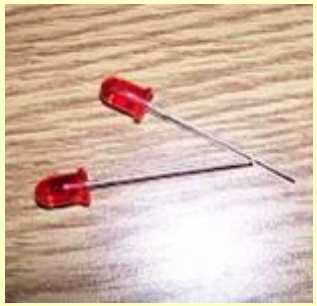


Educational Impact

- Partnership with UPCLOSE
- Evaluation Instruments
  - Field notes, workshop video
  - Pre/Post interviews
  - Parent interviews
  - Surveys after each session
  - Electronic activity logs
- Evaluation Methods
  - Coded responses, i.e. point value assigned to each answer based on a coding scheme
  - Coding verified
  - Sign tests

Knowledge Gains

- More comprehensive and accurate descriptions of a sensor and electric motor
- Identification of more robotic components




Knowledge Gains

- More sophisticated explanations of how an electronic toy worked
  - Pre: “Wires, probably different – I don’t know, things that make the ears move up and down, like wire- not wire-wires, but like – I don’t know.”
  - Post: “Well I – I realized that in the ears, there are servos that make it go up and down.”

Engagement: Workshop Content

- Staying late
- Use logs
- Robot personas (decoration, accessories, narrative development)

Dear old elderly professor Bob
suffered from a head injury
when he ran into an Eskimo…
so now he has a band-aid on his head.
And he's a professor so he has to dress up.
The tie. And he has certain vision problems
so he wears a ‘monocule’ [monocle].

Engagement: Other Technology

- Parent: “I think she probably got an awareness that um computers and technology are in more parts of her life than she realized.”

- Child: “I think I’ve been questioning technology like in my head a little bit more…. Like I wonder how a floppy disk holds memory.”

Confidence

- “The big thing is that when she hits a glitch, she’s like not afraid to kinda, fix it as opposed to ‘eek’”!

Confidence

“In this… workshop, we designed and built robots by ourselves. When we first joined, we had no clue what to do, but now we are confident with our work and our abilities. Robotics has taught us a lot about electronics. Chances are, if you are reading this, you are thinking about joining the workshop. Remember, we are kids too, who [once] knew nothing about robots.”

Plans for 2008

- Workshops taught by community partners
- Revised curriculum
  - Focus on the complete design cycle
    - Earlier introduction of programming
    - Iteration
  - Web component (blog)

Plans for 2008

- Revised robot hardware and software
  - Craft materials
  - Basic design chosen by girls
  - Additional components
  - Custom microcontroller
  - Software
- Explicit learning goals
- Revised evaluation metrics
- Teacher training session

Plans for 2008

- Partners
  - Sarah Heinz House
  - YouthPlaces
  - PALS home school group
- Other Audiences
  - At-risk youth
  - High school students
  - Boys

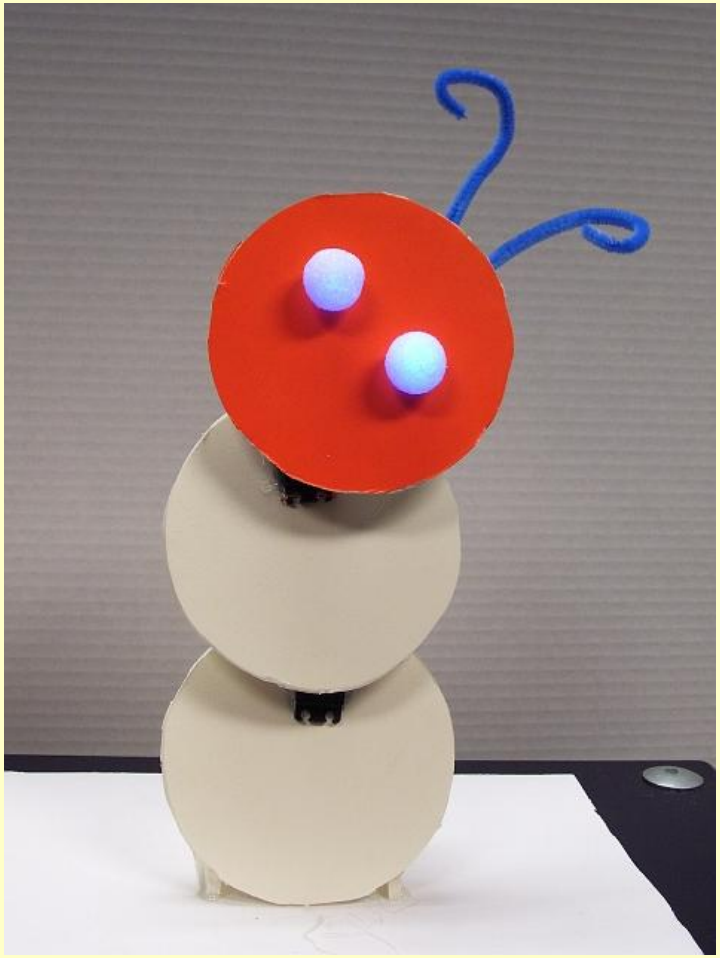
Timeline

- 2006 – participatory design workshops, messaging and expression
- 2007 – educational evaluation
- 2008 – dissemination, sustainability
- 2009 – scaling, commercialization

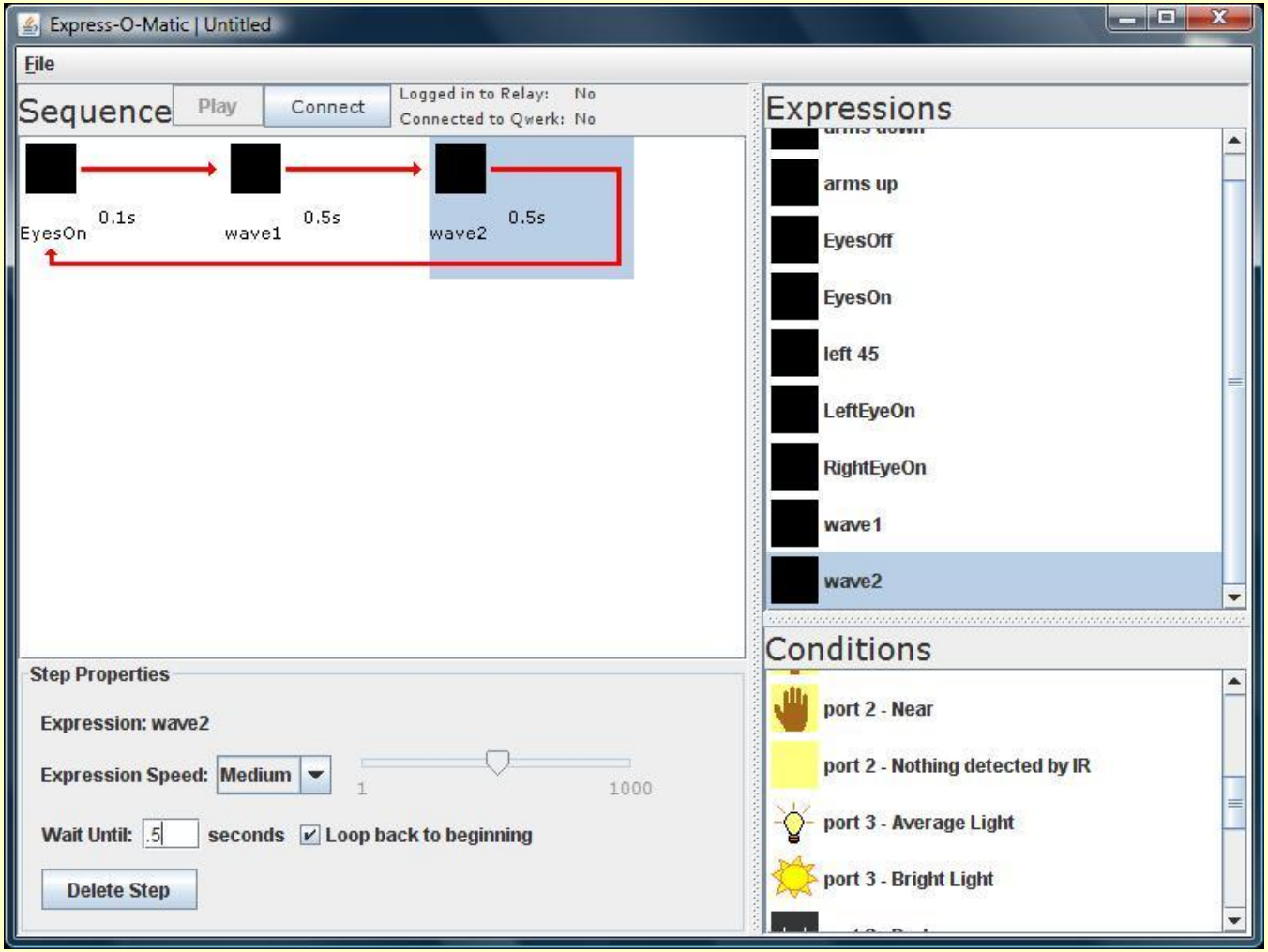
Thanks

- Vera Heinz Endowments
- Participants and Families
- Chris Bartley, CREATE Lab
- Rich LeGrand, CharmedLabs

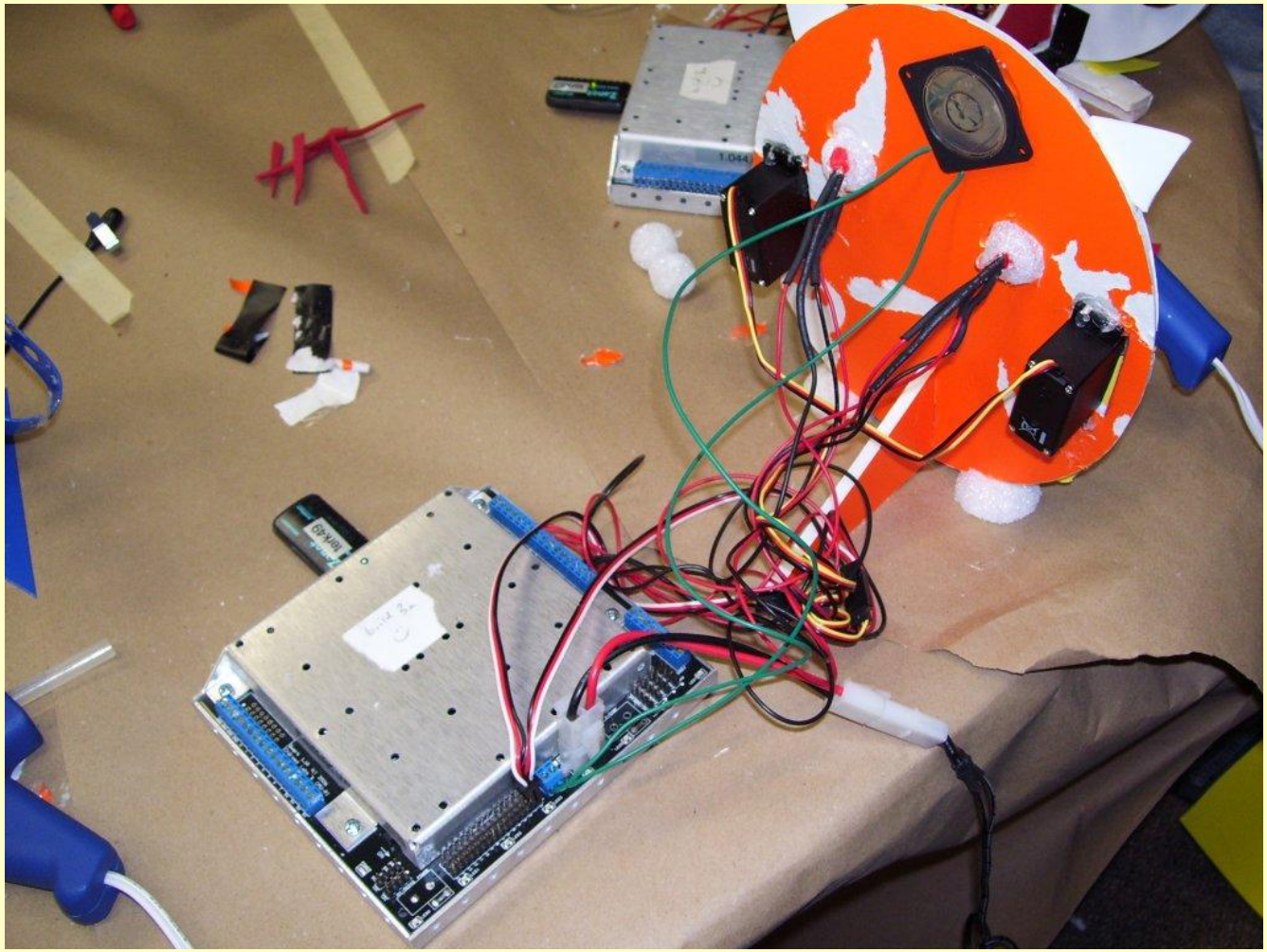
Questions?



Programming Software



Hardware: Qwerk



Do you know what a sensor is? How do you think a sensor works?

- 0 = don't know
- 1 = talks about types of things a sensor can sense (motion, sound)
- 2 = talks about types of things a sensor can sense AND provides some type of explanation that the sensor responds to changes in an environmental stimulus (e.g., a temperature sensor will respond if the temperature drops below a certain point; a light sensor responds to changes in light)
- 3 = describes both components of definition, and also includes some technical description of how the sensor works. Technical descriptions can be of two types: (1) a statement that the sensor generates/sends an electrical signal into the system (e.g., "it sends an electrical reaction") or (2) a statement of how the sensor actually responds to the environment (e.g., "a beam of light goes across the table, and if the beam of light is broken the sensor will go off")

How do you think this toy works?

- 0 = child just talks about toy/what it can do
- 1 = observation of **input-output type action**, but it's vague. They **don't mention what technology** makes the action possible. For example, "pressing a button makes the eyes light up" - there is no mention of the technology involved in making the eyes light up (e.g., LED's); "it makes noise if you pull its tail" – no mention of what technology makes the noise (e.g., speaker)
- 2 = **part-action connection**. Mentions **generic technology** (wires, chips, lights, batteries, speaker, motors, computer) in relation to an action (e.g., pulling it's tail signals the computer to make noise; a chip makes it move)
- 3 = **part-action connection**. Mentions **specific or more sophisticated technology** (servos, LED's, sensors), in relation to an action (e.g., a servo makes the arms move; it moves according to what it's being told from the touch sensor)

Personalization

Engagement