Finding Your Bot-Mate: Criteria for evaluating robot kits for use in undergraduate computer science education

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Robotics is multidisciplinary

- Computer Science
- Mathematics
- Physics
- Engineering/Design
- Psychology/Behavior
- Philosophy
- Cognitive Science
- Communication

Even within computer science

- computer vision/image processing
- AI, machine learning, problem solving
- embedded processors
- multimedia
- compilers/interpreters

Goals for integrating robotics into CS curriculum

- Make learning programming and problem solving more engaging
- Illustrate robust algorithms, closed loop control, sensor-based asynchronous computing
- Images provide a natural context for introducing arrays and discussing multimedia applications

Curriculum possibilities

- Motion experiments in physics
- intro programming
- programming projects
- AI problem solving
- image processing
- networking
- synthesizing complex behaviors
- compiling code for embedded processors

Evaluating Personal Robots

- flexibility and extensibility
- teaching resources, documentation
- development community
- total cost
- programming languages

iRobot (Roomba) Create

- moderately flexible, extensible with command module and home-brew sensors
- not much educational software
- development community is new
- OpenInterface is well documented
- low cost($180)
- programming languages: python, C

Lego Mindstorms Nxt

- Very flexible and extensible, except for camera.
- documentation varies in quality, abundant teaching resources and software
- active development community
- moderately expensive ($250)
- programming languages: Java (lejos), C

Parallax Scibbler

- moderately flexible, IPRE Fluke (with camera)
- good educational resources
- good documentation
- active development community
- least expensive ($150)
- programming languages: PBASIC, Python

	Lego Nxt	Create	Scribbler
prog lang	Java, NXC, C	python, C	PBASIC, python
h/w flexibility	best	moderate	least
ease of setup	moderate	very	very
dev environment	Linux, Win, Mac	Windows	Linux, Mac, Windows
forum	good	medium	good
cost	250	180	160
hardware/memory	320K	64K + 64K flash	32K + 32KROM

Demonstrations

- following a light source
- tracking a red object

Issues

- Although myro is generally good, the compile-run-debug loop is slower with robotics, than just software
- Robotics emphasizes continuous over discrete models
- Robolab has some simulation capability, but is strictly a graphical programming environment
- Simulating the Scribbler would probably be easier than Lego Mindstorms, except for the camera.
- If multiple robots are collaborating, simulation should be at a higher level.

Media Arts

- Robotics is becoming more popular for interactive installations
- May require more hardware flexibility
- Lego Nxt could be used for prototype
- Arduino hardware is the most flexible and cheap ($100), but requires the most work on hardware design.

Undergraduate Research

- Multiple independent agents cooperating to solve a problem that cannot be easily solved by an individual
- Requirements:

effective communication between agents.

rich sensing of the environment, including the other agents

knowledge representation

Conclusion

- Each robot has its own strengths and weaknesses
- The Scribbler has a camera and Bluetooth, so it is good for working with images (rich sensing of the environment) and communication among agents. It is difficult to add new sensors or modify the physical platform
- The Lego Nxt has Bluetooth, and the hardware platform is flexible. It is difficult to add a camera, it is the most expensive, the sensors can be expensive, too. Building the platform can take a significant amount of time
- The Create is flexible for adding new sensors, but you have to build them. It is the least developed in terms of community and code base for students

Talking to your Scribbler

- Python is one of the easiest languages you can use
- myro is a software package that interprets your commands for the Scribbler and IPRE Fluke board
- With myro you can give commands like forward, backward, turnRight, turnLeft, stop, takePicture, get sensor values