Robotics Education in Emerging Technology Regions

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Introduction

- What do we mean by technologically emerging regions?
- Why robotics and AI education?
- What are the challenges?



Two Case Studies

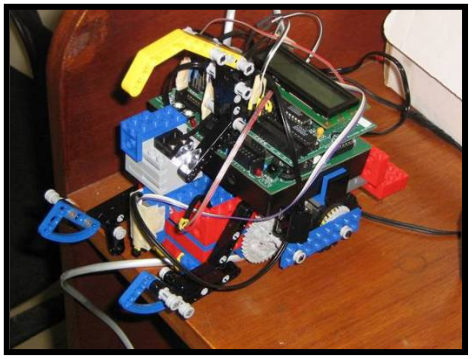
- "Autonomous Robots" course at Carnegie Mellon University in Doha, Qatar
  - Fall 2005, with 17 2nd year students
- "Introduction to Robotics and AI" course at Ashesi University in Accra, Ghana
  - Summer 2006, with 7 3rd & 4th year students

Course Goals

- To introduce students to robotics and to teach them theoretical and practical skills in programming robots
- To expose students to the world of research and enhance their technical creativity and problem solving abilities
- To enable students to apply concepts learned in the CS courses in a laboratory setting
- To expand students' perception of the breadth of CS

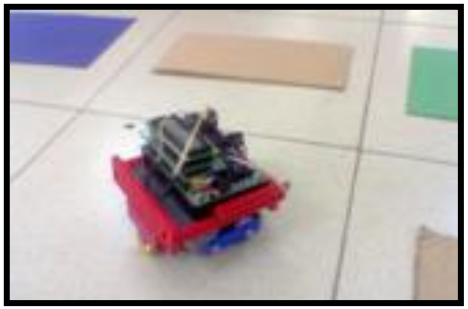
Equipment / Infrastructure

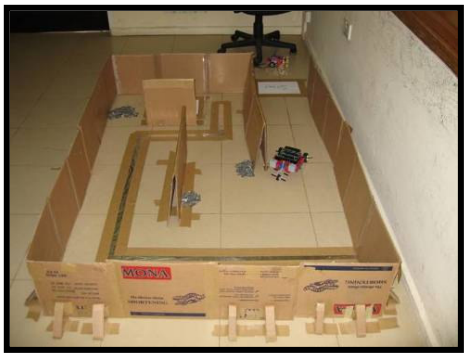
- Qatar: > $50,000 budget (17 students)
  - Robot kits (20)
    - US$650 Evolution Robotics ER1 Robot
    - US$1500 Dell laptop
  - Shipping costs
- Ghana: < $10,000 budget (7 students)
  - $850 Robot kits (9)
    - Lego, Handy Board, sensors, CMUCam
  - Electronics equipment



Structure / Methodology

- Lectures & Labs
- Homework & Lab Assignments
- Quizzes (Ghana only)
- Mid-Semester Research Project (Qatar only)
- Final Project





Similarities Between the Two Courses

- Design Philosophy:
  - Encourage creativity
  - Use local resources (where possible)
  - Teach technical skills
  - Teach dissemination skills
  - Inspire with examples of state-of-the-art
  - Encourage a broad understanding
  - Impact and involve local community
- Changing team composition for each task
- Individual final projects
- Concluding poster session

Differences Between the Two Courses

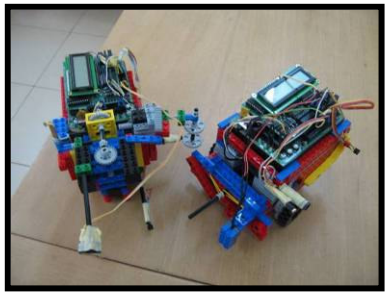
- Duration: 16 wks (Qatar) vs. 9 wks (Ghana)
- Monetary resources: more in Qatar than in Ghana
- Student preparation: 2nd year students (Qatar) vs. 3rd & 4th year students (Ghana)
- Number of students: 19 (Qatar) vs. 7 (Ghana)
- Gender distribution: mostly women (Qatar) vs. mostly men (Ghana)
- Cultural norms: option for same-gender teams in Qatar, not an issue in Ghana

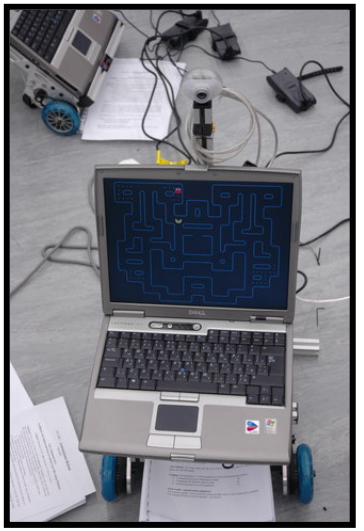
Lessons Learned

- Be creative about student recruitment
- Foster innovation and emphasize breadth
- Make connections to career choices
- Be entrepreneurial
- Build confidence in the relevance of state-of-the-art CS technology to the local context
- Build ties with local community
- Provide research/project opportunities
- Have a plan for sustainability

Outcomes

- Knowledge and technical creativity
- Technical skills
- Confidence
- Awareness of research and professional organizations
- Impact on other academic endeavors
- External interest



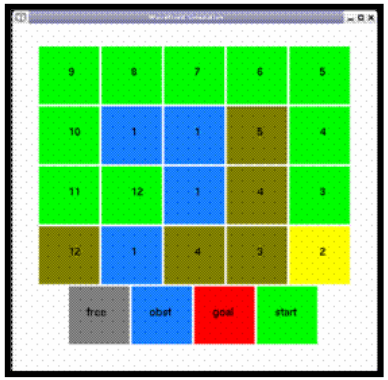


Qatar: Examples of Final Projects

- Robot path planning
  - RRTs
  - Wavefront
- Soccer-playing robots
  - Goalie
  - Attacker
- Entertainment robots
  - Mood changing robot
  - "Pet" robot
- Assistive robotic projects
  - Tour guide
  - Book carrying robot
- Miscellaneous
  - Robot that respond to "traffic signals"
  - Robot that learns best speed to maneuver a ball

Ghana: Examples of Final Projects

- Vision-based estimation of traffic density
- A robot to play tic-tac-toe against a human opponent
- A visualization tool for wavefront planning
- Robot navigation of a changing grid environment using repeated A* searches



Follow-on Work

- "Autonomous Robots" course in Qatar currently being taught again with several enhancements
- Poster session expanded to Meeting of the Minds
- Development of on-line technology educational community (E-Village)
- Investigation of additional low-cost robot platforms and appropriate robotics text-books

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Questions?