Motivating Logical Thinking and Problem Solving

via LEGO® Mindstorms® NXT Robotics

http://computercamp.csufresno.edu

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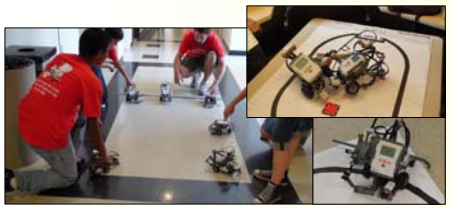
Background

- Fresno continues to serve as an economic hub for the Central Valley and is developing into an Information Technology hub as well.
- Based on the Employment Development Department of the State of California, Computer Science and Computer Engineering related job increases in the **Central Valley** are estimated ***28.6~30.6%*** and ***16.8%***, respectively until 2014.
- Additionally, based on the recent employment predications from the U.S. Department of Labor, among the 825,000 new jobs in the "fastest growing" categories for which a bachelor's degree is the appropriate preparation, a total of ***645,000*** (nearly **80%**) will be **in computing**.
- To fulfill local and nationwide IT workforce needs, the Department of Computer Science at California State University, Fresno, is establishing and implementing new educational programs for the next generation of IT workers.

Team Projects

Sumo Wrester

- Students write code to keep their robots within a circle, but try to push other robots out of the circle. The winner is the robot that remains in the circle after the others go past the line.
- Algorithms:
  - Light sensors detect black solid lines. Accelerate motor(s) w/ direction changes to keep the robot within the circle
  - Touch/ultrasonic sensors detect other robots. Accelerate motor(s) and control arm to push other robots out
  - Different routing strategies and robot body designs to increase the opportunities of finding other robots



Simon Says

- "Simon says" project is similar to synchronized swimming, but in opposite directions. A commander makes a sequence of movement orders to one robot (master). The master sends commands to the other robot (slave). Both robots then perform the action in synchrony in opposite directions.
- Algorithms of Master:
  - Introduce an array to store a sequence of commands
  - Associate different button presses with corresponding movement commands
  - Send the commands to slave through bluetooth
  - Perform movements when sound sensor hears applause
- Algorithms for Slave:
  - Introduce an array to store the commands sent by Master
  - Interpret the array and associate them with opposite movements
  - Send a "readiness" message to Master
  - Perform opposite movements when sound sensor hears applause

Available Projects

- Kick the Can
- Balloon Buster
- Secret Talk
- Hide and Seek
- Autonomous Parallel Parking
- Words Recognition
- Maze
- Crane Control
- Robot Control w/ Webcam
- Robot Control w/ GPS
- Robot Control w/ Speech Recognition
- You name it!

Objectives and Settings

Objectives

- Motivate logical thinking and problem solving
- Encourage students to consider an IT career
- Act as a bridge between high school and college
- Provide a fun summer experience for students

Camp Settings

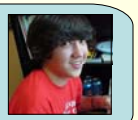
- One Device: LEGO Mindstorms NXT Robots
  - Nationwide study shows LEGO Robots is currently the best means for beginners to learn programming as well as having great potentials for advanced projects
- Two Weeks: Individual projects and team projects are introduced respectively in the first and second weeks
- Two Phases: Introductory camp in mid June and advanced one in mid July
- Two Languages:
  - NXG: A graphical language that programs NXT movements and communications through drag and draw
  - leJOS (subset of Java): Advanced programming language for both introductory and advanced projects

Individual Projects

Knight Rider

- A robot is simulating a vehicle driving across an intersection with traffic lights. If the robot sees a green light (using color sensor), it will maintain the current speed. If the robot sees a yellow light more than 1 foot before the intersection (using ultrasonic sensor) or the light is red, the robot should decelerate and then stop. If the robot is less than 1 foot from the intersection, the robot should accelerate to pass the intersection.
- Algorithms:
  - Students utilize "decision tree" to logically analyze how the robot reacts when meeting different conditions
    - Three light conditions: Green, Yellow, Red
    - Two distance conditions: >= 1 foot, < 1 foot
    - Three speed conditions: maintain speed, acceleration, deceleration
    - Combine different combinations of conditions logically

A black/yellow post-it note acts as a red/yellow light and student's palm acts as an intersection.



Wii Remote

- Two robots are involved in this project: commander and soldier. Commander remotely controls the soldier through a Tilt sensor. The soldier follows the movement orders to find the blue ball and then pick it up.
- Algorithms:
  - Commander uses Tilt sensor (same as the sensor in Wii Remote) to sense the coordinates and speed of movements
  - Commander computes the data from Tilt sensor
  - Commander sends the data to Soldier through bluetooth
  - Soldier receives the data and interprets them
  - Soldier does the corresponding movements

People

K-12 Students

Jayson Dekker, Alta Sierra (Second Right, Front Row)
Ezequiel (Zeke) Esquivel, Roosevelt (First Right, Front Row)
Kevin King, Clovis
Thomas King, Clovis/CART (Third Right, Front Row)
Jared Naito, Bullard (Fourth Right, Front Row)
Maegan Riojas, Roosevelt (Third Right, Second Row)
Austin Wade, Clovis

Student Volunteers

Steve Read (Third Left, Second Row)
Shaen Toner (Second Left, Second Row)

Web Master

Thell Smith