FCRAR Invited Faculty Talk: Robotics at Poly

Dr. Melissa Morris

May 11, 2018

Overview

- **About Florida Poly**

- **Intelligent Robotics Special Interest Group – Areas of Interest**

- **Personal Areas of Work and Interest**

Florida Poly

- ## The newest addition to the SUS system
  - Focused on STEM

- ## Located in Lakeland
  - About an hour southwest of here

- ## Doors opened in 2014

- ## Just over 1400 students and 96 faculty members

- ## Six undergraduate degree programs
  - Data Analytics, CS, CE, EE, ME, and Science and Technology Management

- ## Four Graduate programs
  - New cross-discipline MS program in Robotics

"Mechatronic Building"

- **The IST building roof moves to provide optimal shade in the second floor**
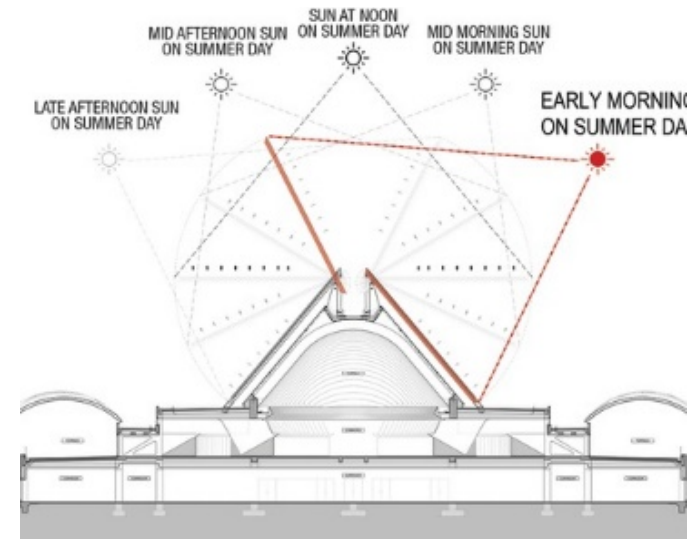
Images: ENR Southeast (May 5, 2014)

IRSIG

- **Four faculty members have recently begun collaborating on research related to robotics**
    - Dr. Balasubramaniyan Chandrasekaran
    - Dr. Ecran Elibol
    - Dr. Ryan Integlia
    - Dr. Melissa Morris

- **Undergraduate students have been working with Dr. Integlia for some time; the team started forming this year with new hires**

- **Graduate students are joining us this Fall**

IRSIG – Areas of Interest

- **Robotics and Autonomy in:**
  - Education and Accessibility
  - Intelligent Agriculture and Environmental Stewardship
  - Rehabilitation, Wellness, and Healthcare
  - Intelligent Transportation Systems and Infrastructure
  - Intelligent Manufacturing
  - Gaming and Augmented Reality

Junkyard Hacks

- Concept for a hackathon focused on the second of the three R's
- Raise awareness of e-waste impact
- Prompt participants to come up with ways to repurpose functional components of discarded electronics, up to and including the entire device
- Discarded electronics could be sourced a number of ways
- Necessary equipment should be provided

- Robotics Software Tools

- **Robot Operating System (ROS)**
  - Robotics middleware
  - Hardware abstraction
  - Device control
  - Communications -- Messaging
  - Packages
  - Robot Models
  - ROS Kinetic – latest distribution
  - Ubuntu 16.04 (Xenial) primarily
  - Linux systems
- **Gazebo**
  - Robot simulator
  - Sensor data generation
  - Existing robotic models
    - Pioneer2 DX
    - iRobot Create, etc
  - Cloud Simulation

Source: http://gazebosim.org/

Results of integrated Hackaday and Workshop

- Average Participations: ~20 students per activity.
- 33% of participation between Hack Day and Workshop
- 10% of participants after workshop join effort to help facilitate future workshops
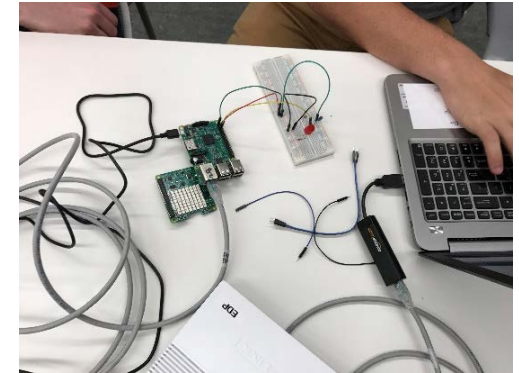

Students working with the SenseHat, a breadboard with discrete components and the Raspberry Pi Microcomputer

FLORIDA**POLY**

Project PaPiYa Educational Technology & Robotics

- **Towards the Math Drag Race Game**

  - Each team will have a tablet controlled wheeled robot.

  - Solve math problems to move wheeled robot

  - Sharing direction from leading team to guide other participating students to finish

1. Luke J. Nichols*, Zachary Weingarten*, Moshe Acevedo*, and R. Integlia. "Networked Wheeled Robotics for Education." Florida Academy of Science. Lakeland, FL. March 2017.
2. Logan Carlson, Zachary Unson, Adam Tarbox, . *Vincent Drewes*, Jonathan Khabbaz*, Xhino Domi*, Eric Williams*, Moshe Acevedo*, Zachary Weingarten†,Luke Nichols*, M. Ullah, M. Abid., M. Cathcart, S. Alsweiss, R. Integlia* "Project PaPiYa: Current Efforts Towards a Network of Accessible Educational Tablets and Development Platform." IEEE GHTC. 2018.
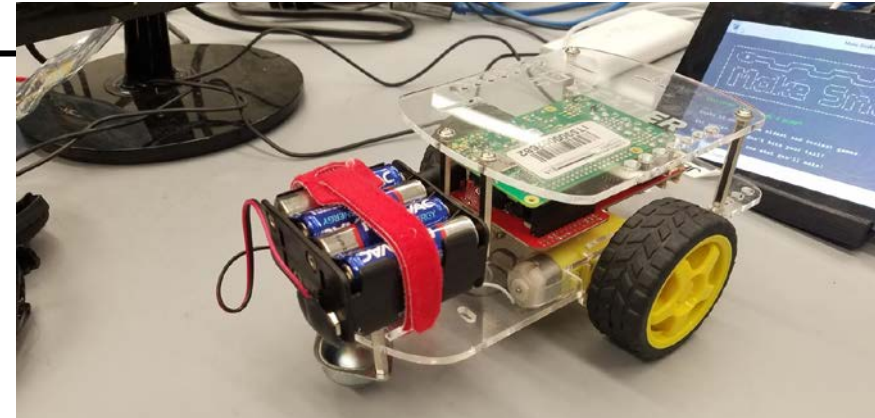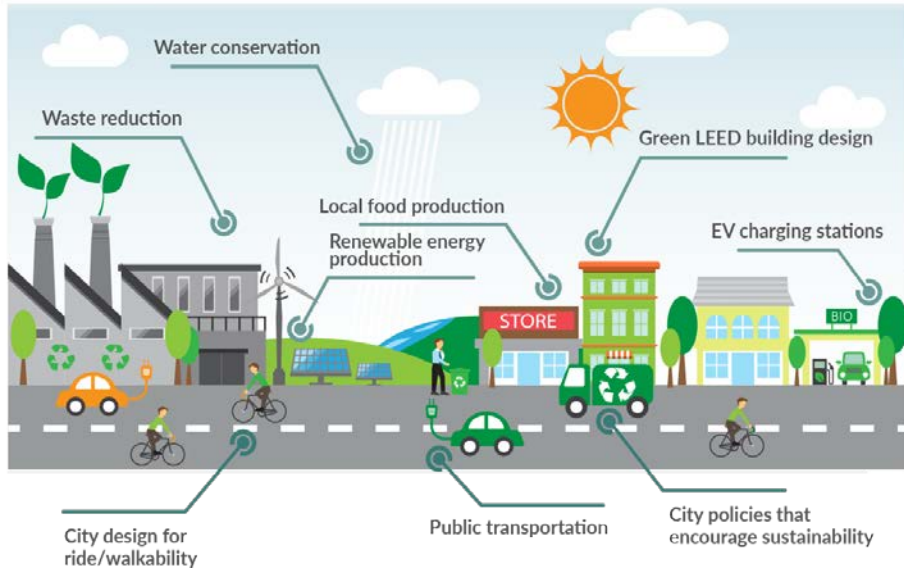

Raspberry Pi based educational tablet with wheeled robot for educational gaming
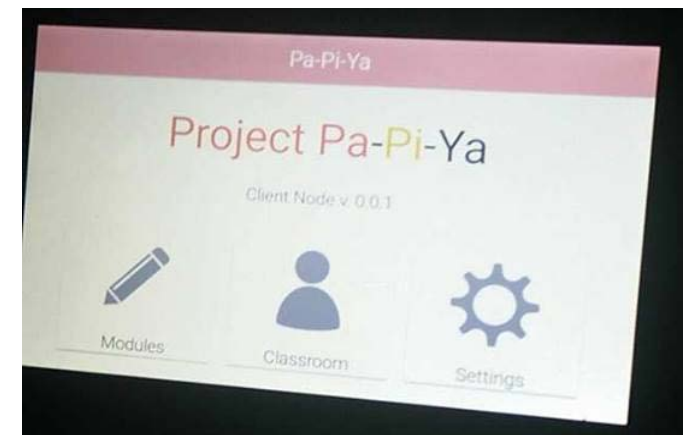
Educational Tablet Controling Robot

Autonomous Solar Electric Vehicle Infrastructure Project & Smart Green Cities

https://www.letsgosolar.com/consumer-education/sustainable-cities/

OSVehicle

Applications for "Smart Green Cities"
>   Reduce harmful emissions
>   Inductive vehicle charging: fast and easy
>   Provide distributed car battery storage for grid
>   Enhance Accessibility, Safety and Efficiency
>   Low-cost green transportation, sustainability

Emerging Technology Access
- Addressing the impact of solar energy, energy storage, software-defined radio (SDRN), RADAR, LiDAR, AI, and internet of things (IoT)
- Converging on an open source electric automobile test bed for Suntrax development

M. Glaser, R. Integlia et al . "Autonomous Electric Solar Electric Vehicle Infrastructure Development." Florida Polytechnic University. Lakeland Electric. 2015.

My Primary Areas of Interest

- ## Rehabilitation
  - Pediatric Rehabilitation
  - Home-based Telerehabilitation

- ## Robotic and Intelligent Agriculture
  - Automated planting systems
  - Automated care
    - Watering and Fertilizing
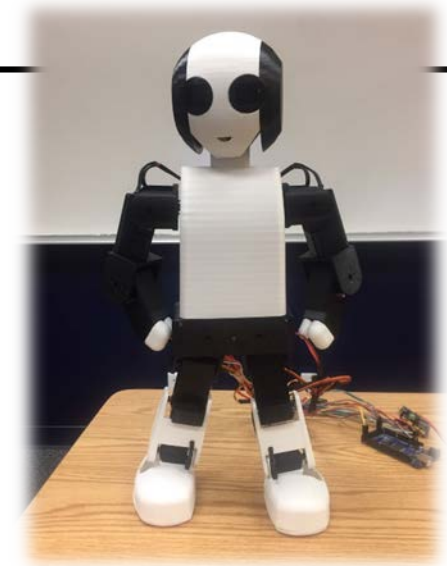   - Weeding and Pest Control
  - Automated harvesting

- ## STEM/STEAM Education

Rehabilitation

- ## Pediatric rehabilitation
  - Challenges:
    - Wide ranges of sizes and abilities
    - Adult systems are not always applicable
  - Benefits:
    - Children are usually open to technology
    - Can motivate children
    - Provides reminders/cues for parents to help

- ## Telerehabilitation
  - Transportation and effort to get to therapy sessions can be a hindrance
  - Rehabilitation must be done everyday and in nearly every activity at home/work/school to be effective
  - Safe systems and protocols are necessary
    - Alternative drive systems including "soft robotics" are one component of this solution being investigated

Intelligent Agriculture

- **Aging farmers and labor shortages are making automated processes on farms imperative for our food supplies**

  – Planting and harvesting of some crops are already automated by large vehicles – some autonomously

  – Adapting current technology or creating brand new vehicles for planting

  – Precision application of fertilizers and pesticides (traditional or organic)

  – Selective and precision application of herbicides or mechanical weeding

  – Efficient and effective harvesting

    – Only take ripe produce
    – Do not bruise produce or damage plant
    – Quick (at least as fast as humans)

Poly's Smart Garden

- **Provides a testbed for many intelligent agricultural experiments**

Education

- **Poly "reset" the curriculum this year to align towards ABET standards**

- **Mechanical Engineering created and implemented a four-year design sequence**
  - Sophomore year was developed to give critical skills usable at a level before engineering sciences courses have been presented
    - Priority was also given to try to make students "remember" why they want to become engineers so that they do not drop out during this critical year when coursework otherwise seems dull or irrelevant to many

- ## **Partnership with Polk County Schools**
  - Exceptional Student Education
  - Doris Sanders Learning Center, Lakeland
    - Students toured the facility in-person
    - Each team identified a problem on their own
    - Teams used newly-learned CAD skills to model prototypes
    - Each team built their prototype during the second semester

Sophomore Impacts

- **Adaptations and personalized equipment for exceptional students is expensive or ad-hoc**
  - Sophomore students provide an engineering service
  - They provided tools that instructors hadn't considered
  - Students gained an appreciation for social issues and problems that are often "hidden"
  - Students worked on something that was real and practical while taking otherwise fundamental engineering science courses

Mechatronics Course

- **Mechatronics was designed to be a Senior Design "Boot Camp" on the integration of mechanical engineering to other disciplines**
  - Projects were developed topic-by-topic throughout the semester culminating in a multi-faceted project
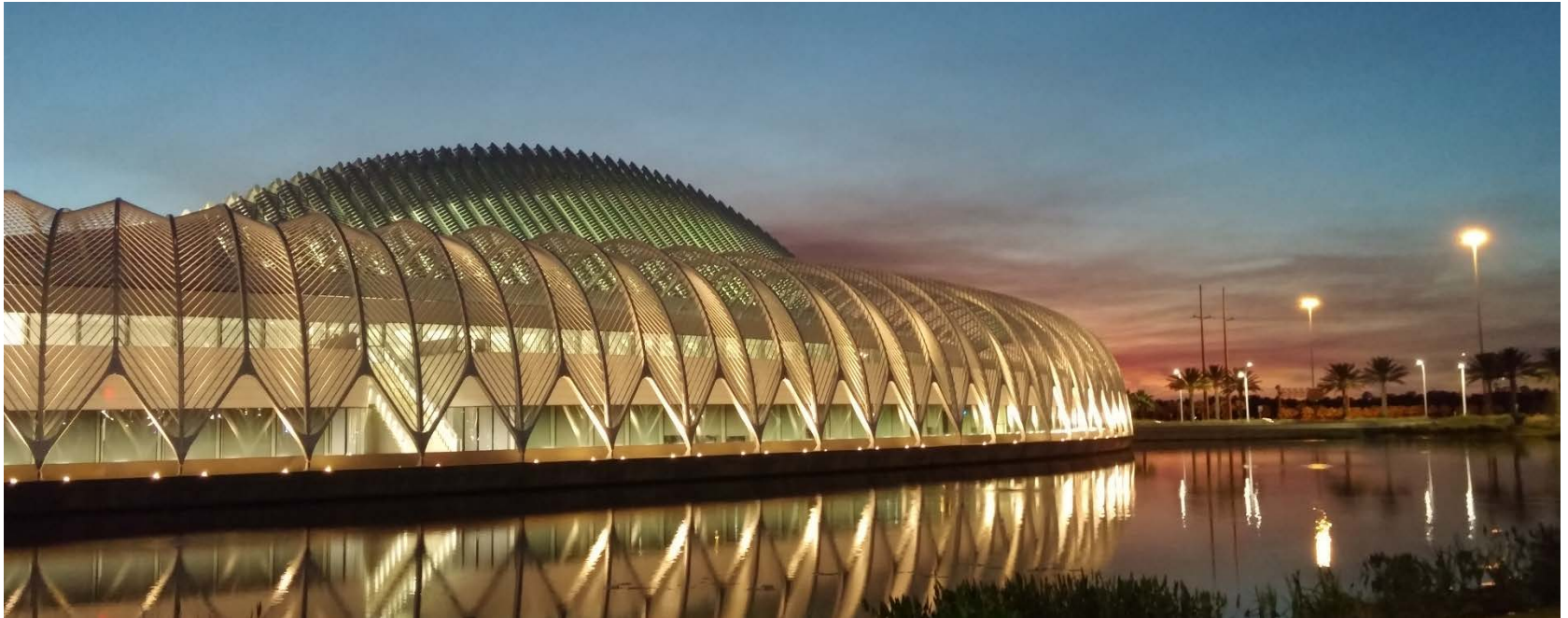
Summary

- **Research is still very much a work-in-progress**

- **Major revisions to the curriculum this year are yielding interesting opportunities and results**

- **We are excited to start a MS program in Robotics next year!**

Thank You!

mmorris@floridapoly.edu