ERTS: A Robotic Platform for Collaborative Experimental Research

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Indiana University School of Informatics and Computing

- Multi-disciplinary programs in Bioinformatics, Chemical Informatics, **Complex Systems**, Data & Search, HCI, Logic, Music Informatics, Security Informatics, others
- Home of IU Computer Science
  - Scientific Computing
  - Grid/Cloud Computing
  - **Programming Languages & Methods**
- Many programs involve robotics
  - **Cognitive robotics**, "embodied intelligence", perceptual interaction, etc.
  - Embedded Systems research & instruction
  - and others
- Robotics research in the process of consolidating
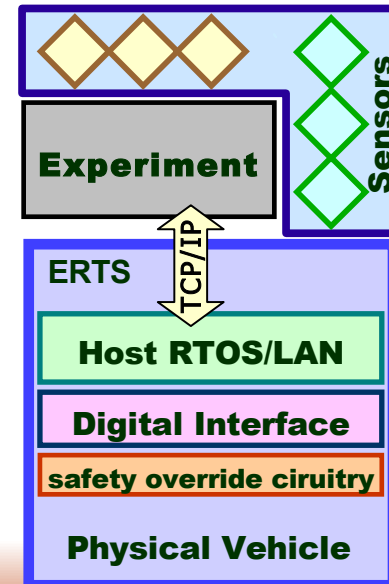
Research Landscape at IU

MIND AND COGNITION

EMBODIED INTELLIGENCE

COGNITIVE ROBOTICS

HUMAN-ROBOT INTERACTION

COMPUTER LEARNING

ARTIFICIAL INTELLIGENCE

ADAPTIVE SYSTEMS

BIOMORPHIC COMPUTATION
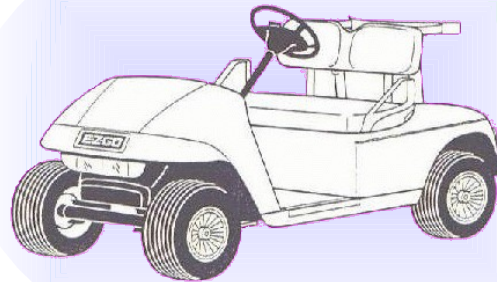
MATHEMATICAL LOGIC

FORMAL METHODS

VERIFICATION & SYNTHESIS

PROGRAMMING LANGUAGES

EMBEDDED & RT SYSTEMS

PERVASIVE TECHNOLOGIES

DIGITAL SYSTEMS

ERTS

- **ERTS** is a standard electric golf car modified for computer control

- Started in 2006

- Ongoing project in our *Embedded & Real-Time Systems* course and laboratory

- **Functional goal:** autonomous real-world navigation

- **Mission:** hosting *experimentation* & *demonstration* across a spectrum of research areas

Experiment

Sensors

ERTS

TCP/IP

Host RTOS/LAN

Digital Interface

safety override ciruitry

Physical Vehicle

ERTS Design Objectives

- **Highly configurable**. Capabilities determined by experimental needs

- **Rapid prototyping.** Fast results; hardware-rich environment.

- **Easy Integration**. Experimentation involving existing systems

- **Minimal tool chain**. Little time for specialized design environments

- **Open Architecture**. Access to deeply embedded functionality

- **Maintainability**. Rapid "turnover"

Current Work

- **CartFS**. Application interface through the *file system*
  - Access ERTS by mounting it as a directory
  - Components present as (memory mapped) file entities
  - *Language independent*
  - *Distributable* via NFS protocols
  - Generic development environment, command-level scripting

- **SyncFS**. Support for *synchronous design methods*
  - Provides a global "*tick*" for synchronization
  - Modifies file read/write operations to occur at a "clock edge"
  - Uses certain coding convention
  - Frameworks for various programming languages

Year of ERTS

- Initiative in 2009-10 to engage with scientists to develop preliminary experimental prototypes

- Identify and design experiments

- Form multidisciplinary teams

- Basic training

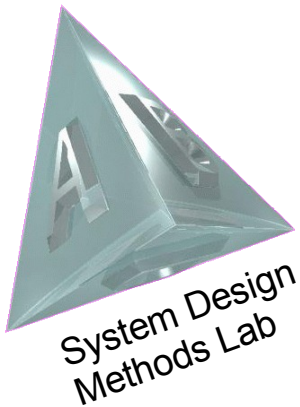- Prototyping and preliminary experimentation

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Embedded & Real-Time
Systems Lab

System Design
Methods Lab