RET: Collaborative Multidisciplinary Engineering Design Experiences for Teachers (CoMET)
"Internet of Things"
University of Central Florida
Orlando Campus

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Dates/Time: June 4 – July 27, 2018; Mon – Fri 8am – 5pm (July 4th week off)

Purpose: To support the STEM educational services for teachers and students in K-12 by providing quality interdisciplinary experiences that are relevant to technical development. The RET site program aims at creating a critical mass of highly qualified teacher trainers who will ensure quality of pre-service and in-service teacher education.

Objectives:

1. To provide teachers with interdisciplinary engineering design experiences relevant to cutting edge technical development.
2. To develop teacher-driven teaching modules that can be deployed in the classroom.
3. To disseminate results and developed materials to help teachers in the region and beyond.

Funding and Professional Development:

- Teachers will receive $6000 for their full participation in the summer RET experience
- Teachers will receive additional funding for participation in Winter Conference and Spring Meeting activities
- Arrangements for Professional Development credit are being negotiated with each county where it is acceptable
- Teachers are encouraged to participate in other development activities (i.e., conferences, publications, further researcher) related to the RET. Additional funds may be available for approved activities.

Deliverables: These deliverables are in addition to short feedback and exit surveys throughout the program.

Summer

1. **Lesson Plan:** RET teachers will develop their own demonstration modules and classroom teaching materials based on the research completed.
2. **Presentation and Report:** RET teachers will present their newly developed teaching modules to the researchers and team members for evaluation and feedback.
3. **Implementation Estimate:** Teachers will inform the researchers when (fall or spring term) the module will be implemented in the classroom.

Fall (Winter Conference)

1. **Student Products/Outcomes**: Teachers who implemented the lesson in fall semester will provide the researchers with two student products at the winter conference attended by all RET participants.
2. **Modified Lesson Plan**: Using the in class experience and feedback from the researchers and team members, teachers will modify and submit a new lesson plan for a second implementation (following year or semester).

Spring

1. **Dissemination of Work:** Teachers will showcase the classroom lessons and prototypes at the annual Florida Engineering Education Conference (FEEC) hosted by iSTEM at UCF. Another conference may be acceptable, but must be approved in advance.
2. **Student Products/Outcomes:** Teachers who implemented the lesson in spring semester will provide the researchers with two student products at the spring meeting attended by all RET participants.
3. **Modified Lesson Plan**: Using the in class experience and feedback from the researchers and team members, teachers will modify and submit a new lesson plan for implementation in the second year.
4. **Final Analysis**: Teachers will submit a final reflection on the RET and implementation of modules in their own classrooms.

RET program schedule:

Week	Mon	Tue	Wed	Thu	Fri
1	Orientation Lab tour	Lab safety Library orientation	Begin research	Research	Research
2-5	Workshop	Research	Research	Research	Research
6	Workshop	Research	Research	Research	Presentations

Research Project Modules: With 3-4 teachers in a team, each team will spend 1-2 weeks in each module in sequence to complete their projects.

Sensor Device Module (Teachers will choose one of three different sensor projects depending on their background and interest.) – 2 weeks

Option 1: Design and Fabrication of Environmental Sensors (*Chemistry, Physics and Environmental Sciences*) – Working principles: Material synthesis, Photomask Design, Cleanroom Microfabrication, Device packaging

Expected Outcome of Research

(a) Learn about the electrochemical reactions that can be used to monitor environmental pollutants

(b) Gain knowledge and hands-on skills in the area of cleanroom microfabrication – additive and subtractive processes including photolithography and etching

(c) Establish methodology to characterize and validate sensor performance characteristics

Technology Dissemination to Classroom

- A prototype device and instructional materials for K-12 teachers in Chemistry (electrochemistry), Environmental Sciences (environmental sensors) and Physics (photon-based processes)

Option 2: Design and Fabrication of Resonant Sensors (*Physics*) – Working principles: Photomask Design, Cleanroom Microfabrication, Device packaging

Expected Outcome of Research

(a) Learn about piezoelectric MEMS resonators and their application.

(b) Acquire hands-on skills in RF device testing and characterization, dicing, and wire-bonding.

(c) Understand complexities associated with wireless sensing and methodologies to characterize wireless sensing performance

Technology Dissemination to Classroom

- A prototype device and instructional materials for K-12 teachers in Physics and Chemistry

Option 3: Digital manufacturing for Strain Sensors (*Chemistry and Physics*) - Working principles: Composite material fabrication, 3-D printing

Expected Outcome of Research

(a) Learn about relationship between the electrical resistance of carbon nanotube film and the mechanical strain of composite structures for strain sensor design

(b) Gain knowledge and hands-on skills in the area of digital design and manufacturing of strain sensors

(c) Establish the methodology to characterize and validate the strain sensor performance characteristics

Technology Dissemination to Classroom

- A prototype device and instructional materials for K-12 teachers in Physics and Chemistry

Interface and Testing Module – 2 weeks

Interface Hardware Design for Sensors and Device Testing (*Physics, Computer Literacy*) – Working principles: Analog and digital circuit basics, Data analysis and validation

Expected Outcome of Research

(a) Learn how to select the appropriate development kits for specific applications and learn how to adapt the design templates provided by development kit vendors for new implementations.

(b) Explore existing open-source software resources which can be used for OS construction on top of the already constructed IoT hardware platforms; Application-specific user interface development for special functionality and design efficiency.

(c) Learn how to debug the entire IoT system including the hardware platform and the firmware for specific applications; Understand different debug interfaces and their usages.

Technology Dissemination to Classroom

- FPGA platform based sample IoT designs and the detailed design process for K-12 teachers in Engineering, Computer Science, Information Science, and Physics.

Software and Networking Module – 1 weeks

System Software (*Computer Literacy*) – Working principles: The basics of the Linux operating system. Processes and files. Accessing input/output devices. Linux on the Raspberry Pi. Introduction to the Java programming language.
Networking (*Computer Literacy*) – Working principles: The basics of computer networking, the layered model. Principles of TCP/IP, Addresses and sockets, Programming a simple web server in Java on the Raspberry Pi.

Expected Outcome of Research

Overall, this project will help gain deeper understanding of the methodologies and tools used for creating and testing modern software and mobile software elements. Specific deliverables of this work include:

(a) A collection of programming assignments and sample solutions that will lay the foundations for programming the software stack for sensor and mobile communication and sensory data storage and retrieval; fundamental concepts that will be covered include computer programming using Java, data input and output, file systems, and operating systems.

(b) Software design and implementation for sensory data communication and transmission. The software will support the transmission of dynamic content over a computer network.

(c) The design of a mobile web server using Java that will implement the capability of transmitting the sensory data over a computer network. This will allow the RET teachers to learn about socket programming and its adaptation to mobile platforms.

Technology Dissemination to Classroom

- The materials used in the principles and practice parts of the proposed modules will be provided to K-12 teachers for use in classes on Computer Programming.

Mobile Programming Module – 1 weeks

Mobile Programming (Computer Science) – Working Principles: mobile operating systems, Introduction to Android, Writing a simple Android program accessing the web.

Expected Outcome of Research

(a) Understand the components comprising the Android platform and be able to use various tools found in the Android development environment.

(b) Learn how to write a simple Android application.

(c) Gain ability to connect the Android application to Raspberry Pi hardware platform to receive sensory data based on guided steps

Technology Dissemination to Classroom

- The Android platform used in the proposed modules will be provided to K-12 teachers for their use in classes.