COVER SHEET FOR GRANT PROPOSALS

State Board of Education

SBOE PROPOSAL NUMBER: (to be assigned by SBOE)	AMOUNT REQUESTED: $39,400

TITLE OF PROPOSED PROJECT:
Development of an Independent Fault Monitor to Increase Safety And Marketability of the Advanced Accessible Pedestrian System

SPECIFIC PROJECT FOCUS:
Provide enhanced monitoring capability for advanced accessible pedestrian systems for safe and reliable operations to assist blind and physically handicapped pedestrians at signalized intersections.

PROJECT START DATE: 7/1/2011	PROJECT END DATE: 06/30/2012
NAME OF INSTITUTION: University of Idaho	DEPARTMENT: National Institute for Advanced Transportation Technology

ADDRESS:
University of Idaho
P.O. Box 440901
Moscow, ID 83844-0901

	E-MAIL ADDRESS: rwall@uidaho.edu	PI PHONE NUMBER: (208) 885-7226

	NAME:	TITLE:	SIGNATURE:
PROJECT DIRECTOR	Dr. Richard Wall	Professor	Richard W. Wall
CO-PRINCIPAL INVESTIGATOR			
CO-PRINCIPAL INVESTIGATOR			
CO-PRINCIPAL INVESTIGATOR			

	NAME:	SIGNATURE:
Authorized Organizational Representative	Polly Knutson	Polly Knutson
	AMB 5-20-11	

SUMMARY PROPOSAL BUDGET

Name of Institution: University of Idaho
Name of Project Director: Dr. Richard Wall

A. FACULTY AND STAFF

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
Richard Wall, Professor	60.04			1	$9,607
% OF TOTAL BUDGET:	24%			**SUBTOTAL:**	$9,607

B. VISITING PROFESSORS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
% OF TOTAL BUDGET:				**SUBTOTAL:**	

C. POST DOCTORAL ASSOCIATES / OTHER PROFESSIONALS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
% OF TOTAL BUDGET:				**SUBTOTAL:**	

D. GRADUATE / UNDERGRADUATE STUDENTS

Name/ Title	Rate of Pay	No. of Months CAL	ACA	SUM	Dollar Amount Requested
Cody Browne, Electrical Engineering Graduate Student	16.50		9	3	$20,435
% OF TOTAL BUDGET:	52%			**SUBTOTAL:**	$20,435

E. FRINGE BENEFITS

Rate of Pay (%)	Salary Base	Dollar Amount Requested
Project Director (23%)	$9,607	$2,210
Graduate Student (9% summer, 1% academic year)	$20,435	$848
	SUBTOTAL:	$3,058

F. EQUIPMENT: (List each item with a cost in excess of $1000.00.)

Item/Description	Dollar Amount Requested
Computer hardware and enclosure	$2,500
SUBTOTAL:	$2,500

G. TRAVEL:

Dates of Travel (from/to)	No. of Persons	Total Days	Transportation	Lodging	Per Diem	Dollar Amount Requested
Moscow to Boise	4	3	$550	$600	$350	$1500
Moscow to Boise	4	3	$550	$600	$350	$1500
					SUBTOTAL:	$3000

H. Participant Support Costs:

	Dollar Amount Requested
1. Stipends	
2. Travel (other than listed in section G)	
3. Subsistence	
4. Other	
SUBTOTAL:	

I. Other Direct Costs:

	Dollar Amount Requested
1. Materials and Supplies	$800
2. Publication Costs/Page Charges	
3. Consultant Services (Include Travel Expenses)	

4. Computer Services	
5. Subcontracts	
6. Other (specify nature & breakdown if over $1000)	
SUBTOTAL:	$800
J. Total Costs: (Add subtotals, sections A through I) **TOTAL:**	$39,400
K. Amount Requested: **TOTAL:**	$39,400
Project Director's Signature: Richard W. Wall	Date: May 18, 2011

INSTITUTIONAL AND OTHER SECTOR SUPPORT

(add additional pages as necessary)

A. INSTITUTIONAL / OTHER SECTOR DOLLARS

Source / Description	Amount

B. FACULTY / STAFF POSITIONS

Description

C. CAPITAL EQUIPMENT

Description

D. FACILITIES & INSTRUMENTATION

Description

SBOE Idaho Incubation Fund Program Proposal

DEVELOPMENT OF AN INDEPENDENT FAULT MONITOR TO INCREASE SAFETY AND MARKETABILITY OF THE ADVANCED ACCESSIBLE PEDESTRIAN SYSTEM

FACULTY MEMBER DIRECTING PROJECT: Richard W. Wall, National Institute for Advanced Transportation Technology (NIATT) researcher and professor in the Department of Electrical and Computer Engineering

INSTITUTION: University of Idaho

"GAP" PROJECT OBJECTIVES AND TOTAL AMOUNT REQUESTED: We are requesting $39,400 of incubator funds to develop and test an environmentally hardened pedestrian fault monitor (PFM) for an Advanced Accessible Pedestrian System (AAPS). An AAPS provides audible signals to visually impaired pedestrians at signalized intersections. The AAPS was developed by the University of Idaho (UI) in collaboration with Campbell Company of Boise, Idaho. Campbell Company licenses the AAPS from the UI and markets the AAPS nationally. A PFM will add capabilities to the AAPS that allows it to meet evolving traffic industry expectations for reliable and predictable safe-fail operations and consequentially enter international markets.

Fault monitoring for the AAPS is substantially different from fault monitoring for conventional traffic controllers. Today's traffic controllers implement a central control scheme where it is possible to monitor all signal outputs from one central location. The AAPS is part of a new generation of traffic control schemes that uses multiple processors, spatially distributed around the signalized intersection. Since the AAPS is capable of receiving and sending communication, the communications traffic potentially can be monitored by an independent fault monitoring device, such as the proposed PFM, thus increasing the safety and reliability of the system. Research is ongoing at the state and federal level to implement a new generation of vehicle traffic signal systems that will use similar distributed control techniques. The PFM technology will also be directly transferrable to the fault monitoring that will be required for these new vehicular traffic signals.

Because the AAPS was designed and tested at the UI, we are uniquely positioned to provide the research and engineering resources that will result in economic benefit for the UI and the State of Idaho. With the cooperation of the City of Moscow, we will field-test the PFM in the installed AAPS system at the intersection of 6th and Deakin Streets. Following the beta testing, the PFM will reach a technology readiness level (TRL) of 9, indicating it is ready for production and integration with future AAPS installations. Based upon our previous experience with developing the AAPS, and our ongoing relationship with Campbell Company, we expect that the PFM can be ready for production by June 2012.

The UI holds all intellectual property rights to the AAPS system and has licensed that original technology to Campbell Company. Campbell has agreed to license the PFM technology from the UI upon successful completion of the beta-testing phase, then begin manufacturing the equipment and marketing it with the AAPS. The "gap" project will encompass the development of the PFM, the integration of the PFM into the AAPS system, and field-testing of the PFM.

PROJECT RELATIONSHIP TO HOME INSTITUTION PRIORITIES: This project is aligned with the priorities of the UI and the mission of the Office of Technology Transfer, which is to promote the timely transfer of commercially valuable knowledge developed at the UI to the businesses most capable of reducing them to practice. This research is also in alignment with the core mission of NIATT to develop engineering solutions (knowledge and technology) to transportation problems for the state of Idaho, the Pacific Northwest, and the United States.

POTENTIAL IMPACT TO IDAHO ECONOMY: The PFM will be manufactured and marketed by Campbell Company of Boise, Idaho, with whom the UI has a strong alliance associated with the commercialization of the AAPS.[1] This project contributes directly to the economic income of the UI by enhancing the marketability of a technology currently licensed to an Idaho-based company. The need for a PFM device was originally suggested to Campbell Company engineers by a traffic engineer in Vancouver BC, Canada. The addition of the PFM to the AAPS will make the combined device more marketable in both the U.S. and Canada.

Recent changes in the U.S. Department of Transportation guideline known as the Manual for Uniform Traffic Controller Devices (MUTCD) require that new and renovated signalized intersections with pedestrian access have APS capability.[2] The Federal Highway Administration "2007 National Traffic Signal Report Card" reported more than 272,000 traffic signals in the U.S. According to the VP of technology at Econolite Controls Inc., the estimate of signalized intersections today is from 300,000 to 350,000. Conservatively speaking, there have been an estimated 30,000 new signalized intersections installed in the U.S. in the past three years.

No documentation is available to indicate how many current signalized intersections are not equipped with APS. A survey of the intersections in Moscow, Idaho may be one indication of the potential market for APS devices. Only one of the 18 signalized intersections in Moscow is equipped with an APS pedestrian signal. Manufacturer's data indicate that the typical lifetime of a traffic controller is 15 years. Based upon the data available, we predict that there will be approximately 22,500 intersections upgraded each year for the next 12 years in addition to 10,000 new intersection installations per year.

The traffic controller industry has also adopted a policy of requiring independent verification of vehicular traffic controller signal operations regardless of the reliability of controller equipment. These devices, called Conflict Monitors (CM) or Malfunction Management Units (MMU), monitor the voltages that light the signals around the intersection to ensure that no set of signals are activated that would result in hazardous traffic patterns. CM or

MMU devices for traffic signal control installations have been mandatory since 1976 in order to meet the National Electrical Manufacturers Association (NEMA) specifications. The accepted practice of independent monitoring is now being extended to pedestrian audible signals. This was not previously required, not because it was not a good idea, but because previous equipment was incapable of bidirectional communications. Now that the AAPS has the ability to report its status, the traffic industry is eager to extend the MMU concept to audible signals.

Two major companies in the U.S. manufacture APS controls: Polara, located in Corona, California, and Campbell Company, located in Boise, Idaho. Campbell Company will offer the independent fault monitoring as an option for future and in-process AAPS systems. Potential customers for this product include state, county, and city traffic agencies throughout the United States, U.S. territories, Canada, and Mexico.

SPECIFIC PROJECT PLAN AND USE OF FUNDS: The funds provided by this research grant will be used to provide our industrial partner (Campbell Company) with engineering designs and construction details to allow manufacturing of the new PFM to begin as soon as beta testing has been completed.

The fundamental goals for this proposal will be:

1. Assess the fault risks and failure modes of a network-based safety-critical distributed network.
    a. Identify methods of fault detection.
    b. Develop actions to appropriately mitigate the various fault types.
2. Develop a field-tested engineering reference model of the PFM.
    a. Select the necessary electronic components.
    b. Develop computer code.

3. Commercialization

    a. Develop a detailed bill of materials.

    b. Generate fabrication and assembly plans.

    c. Provide training to industrial partners to assist in manufacturing.

Technology: Currently traffic signals use centralized control whereby a single computer executes all control logic functions. The outputs controlling the signals and the inputs for sensing vehicles and pedestrians are connected to the central computer by direct wiring. These output and inputs are constrained to binary (on or off) operations. The AAPS is a distributed processing environment where the control logic is distributed among numerous processing units. Each of the distributed units generates the control signals and senses the inputs local to the unit's spatial environment. This information is communicated to the other control units using communications network messages. Implementing a pedestrian control system based upon distributed control methodologies is a necessary first step in providing an infrastructure that is adaptive for the next generation of traffic signals.[3]

The PFM will be a passive system that monitors the Ethernet communications between the advanced pedestrian controller (APC) and the distributed network of advanced pedestrian buttons (APB) as illustrated in Figure 1. The APC portion of the AAPS is located in the intersection control cabinet. The APB devices are installed in close proximity to intersection crosswalks (see Figure 6 in the appendix). Pedestrians push a mechanical button that results in a signal being sent to the traffic controller that will in due course result in activation of the WALK light. The PFM will acquire the pedestrian station–traffic signal mapping table maintained by the APC to determine which station walk messages are compatible with the presently active walk signals. Upon the detection of an incompatible condition, the power to all pedestrian buttons will be removed to prevent any audible messages from being played. The loss of power to pedestrian buttons will result in the APC receiving no communications from any pedestrian button. The APC is engineered to place a persistent call to the traffic controller for any button for which the APC has no communications. This provides pedestrians with walk cycles even if the AAPS should fail to operate correctly. If the traffic controller cabinet is equipped with internet connectivity, an email notice can also be sent automatically to traffic agency personnel.

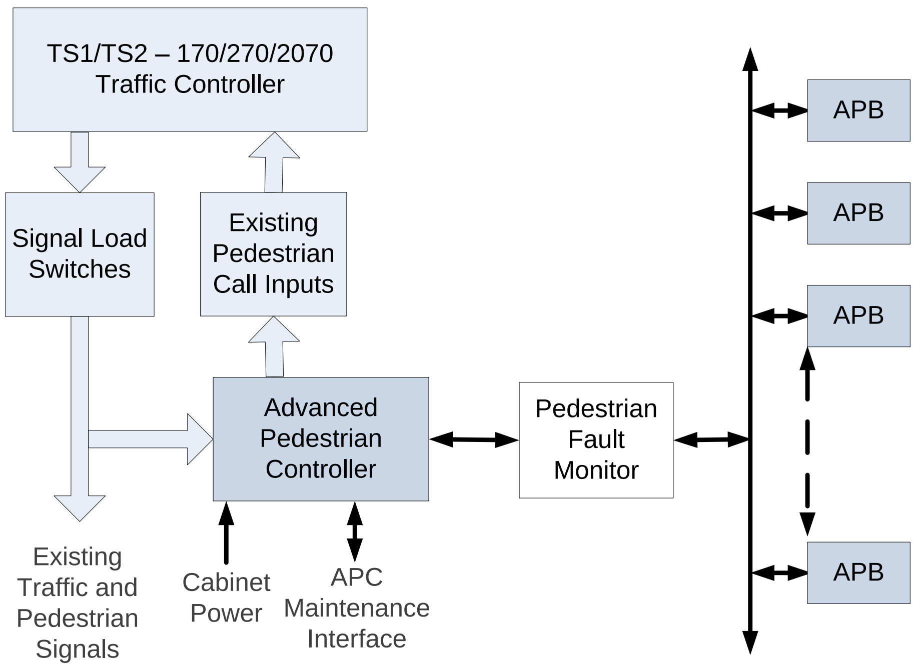

Figure 1. Block diagram of placement of the Pedestrian Fault Monitor into a traffic controller cabinet that is equipped with an AAPS

The fact that the AAPS can and does report actions regarding the audible messages is an important improvement over previous accessible pedestrian systems. The current AAPS is capable of selectively disabling any pedestrian button that has failed. However, as noted previously, the traffic industry is not satisfied with electronic devices evaluating their own performance, so it is likely that independent monitoring will be required for future accessible pedestrian systems. A PFM will help new AAPS systems meet these requirements.

The PFM design is based upon standard Ethernet communications, National Electrical Manufacturers Association equipment specifications, and network communications defined by the National Transportation Communications for Intelligent Transportation Systems Protocol. These standards have governed traffic control equipment manufacturing for over 40 years. The design of the AAPS received a Federal Highway Administration letter of compliance that demonstrates our capability to design to these standards.

Specific hardware components have been selected to meet the singular basic requirement: turn off all power to APBs if a fault is detected. Figures 2 through 4 (see appendices) show the packaging of the PFM hardware and the relationship to the APC, the MMU, and the traffic controller. Through previous operational analysis using Failure Effects and Modes Analysis (FMEA) techniques, we have determined the modes of operation and potential failure modes involving network messages.[4] We have chosen a commercial off-the-shelf (CoS) system that will be purchased from Technologies Systems Inc., which has been operating for over 25 years. This system has an operating system compatible with the existing APC. The software for the PFM computer system will be based upon AAPS network communications technology that has been proven by test installations in Idaho, Indiana, Nevada, and Minnesota (in operation since February 2010). Computer program code from the APC will be ported over to the new PFM system. Utilizing CoS hardware and reusing proven computer code radically reduces the development cycle and the time to production.

Team Personnel and Qualifications: The project team will include Richard Wall as project director, Cody Browne, graduate student in electrical engineering, and two additional undergraduate electrical engineering students. Dr. Wall has 18 years of industrial experience designing communications systems and electronic instrumentation and control systems. He has 21 years of research and teaching experience in the area of embedded systems and networked-based controls. Cody Browne is a first year graduate student who has worked with the Smart Signals research team for three years and is the principal developer of the computer code used in the APC. Benjamin Sprague and Ben Jochen are electrical engineering undergraduates who started working on the Smart Signals Team in January 2011.

Project Tasks, Milestones, and Schedule:

Research Timeline 2011–2012	**July '11**	**August**	**September**	**October**	**November**	**December**	**January '12**	**February**	**March**	**April**	**May**	**June**
Analyze network communications protocols	■	■	■									
Program PFM computer		■	■	■								
Generate test plan	■	■	■	■	■	■	■					
Laboratory testing				■	■	■	■	■	■	■		
Field testing in Moscow							■	■	■	■	■	
Performance documentation				■	■	■	■	■	■	■	■	
Field tests: Campbell Company								■	■	■	■	
Report of findings												■

Performance Metrics: The PFM will be designed to detect communication error between the APC and APBs. The sole performance metric will be to demonstrate that the PFM will turn off the power to all APBs in the event of a loss of integrity in the communications data. Normal operations will be restored only after a visit by a technician to reset the system manually. Hence, the system has a three step process: 1) Detect information errors in the network communications; 2) Remove power to the APBs; and 3) Reset the system. There is an implied maintenance procedure by the technician between Steps 2 and 3, and an observation period after Step 3.

Proposed Budget: Funds provided by this grant will support the project director for approximately four weeks to direct and conduct engineering design, develop field-testing protocols, supervise equipment installation in the traffic controller at the test site, and evaluate test results. The funds provided for a graduate student are to provide software programming and prototype fabrication for 37 weeks (20 hrs. per week) and 12 weeks of summer employment (40 hrs. per week) at $16.75/hr. The travel expenditures will used for trips to Boise to meet with Campbell Company personnel and facilitate the technology transfer and integration of the PFM hardware into the AAPS. Funds also provide for purchase of an industrial-grade single-board Linux based computer, an environmentally hardened network hub/managed router, and an enclosure.

Expenditure	**July–Aug '11**	**Sep '11–June '12**
Salaries/wages		
Graduate Student (MS student) (Fringe @ 9% summer, 1% academic year)	$8,040 $724	$12,395 $124
Project Director (approx. one month) (Fringe @ 23%)	$9,607 $2,210	
Equipment (computer hardware and enclosure)	$2,000	$500
Materials and Supplies (telephone, copier, technician support)	$400	$400
Travel (in-state)	$1,500	$1,500
Subtotals:	$24,481	$14,919
Project Total:	**$39,400**	

EDUCATION AND OUTREACH: Under the supervision of the project director, students will learn how to develop and test network-based control systems. Students will learn to analyze existing systems to understand the requirements and to define the operating characteristics of a new system to meet required specifications. Students will gain experience working with industry professionals by participating with field installation and testing. Attracting quality electrical and computer engineering students to the transportation industry is important because the field is predominately served from civil engineers who are not educated in the areas needed to apply high-technology devices. The electrical and computer engineering students will experience the process of assimilating knowledge in a totally new area and applying their talents to solving a technology base problem.

INSTITUTIONAL AND OTHER SECTOR SUPPORT: The PFM will use Smart Signals Technology developed at the UI from funding provided by the U.S. Department of Transportation, The Idaho State Board of Education, and Campbell Company. Our industry partner, Campbell Company, has been providing pedestrian control devices to the traffic industry since 1972. Campbell Company relocated to Boise in 1998 and is an ISO 9001 compliant manufacturing company. They support our present research by manufacturing the electronic components that are designed by the Smart Signals research team at the UI, providing research funding, and offering technical input. Last year, Campbell Company hired a Master of Science electrical engineering student whose thesis focused on an element of AAPS. UI researchers meet with Campbell Company weekly and communicate about project development using a project wiki (http://pedlab.ece.uidaho.edu/dokuwiki/doku.php). Support for this project is also provided by NIATT and the Department of Electrical and Computer Engineering Traffic Controller Development Laboratory at the UI, which has the necessary traffic control equipment to replicate a signalized intersection, development computers, and software.

Past, Current, and Pending Support for the AAPS System

Supporting Agency and Status	Total Amount	Dates	Title of Project
Campbell Company – Active	$122,187	Sept. 2008–Dec. 2011	Networked Accessible Pedestrian Signals
US DOT UTC – Active	$124,633	Sept. 2010–Aug. 2011	Smart Signals Countdown Pedestrian Signal
US DOT UTC – Complete	$111,723	Sept. 2009–Aug. 2010	Closed Loop Operation of Network Based Accessible Pedestrian Signals
US DOT UTC – Complete	$117,357	Sept. 2008–Aug. 2009	Commercialization and Field Distribution of Smart Pedestrian Call Signals
Idaho State Board of Education - Higher Education - Complete	$75,000	Jan. 2008–Dec. 2008	Advanced Interactive Signals for Able-bodied and Disabled Pedestrians

APPENDICES:

REFERENCES:

[1] Wall, R. W. "KLK715: Commercialization and Field Distribution of Smart Pedestrian Call Signals," http://www.webs1.uidaho.edu/niatt/research/Project_Descriptions/KLK715.htm.

[2] "Manual for Traffic Controller Devices 2009," US Department of Transportation Federal Highway Administration, available at http://mutcd.fhwa.dot.gov/.

[3] DeRuwe, Gabriel and R. W. Wall, "Pedestrian Navigation and Integration with Distributed Smart Signal Traffic Controls," The 34th Annual Conference of the IEEE Industrial Electronics Society, Orlando, FL, November 11, 2008, Paper # HD-010979

[4] "10 Steps to Creating a FMEA," Leadership, Lean, and Six Sigma Academy, available at http://lssacademy.com/2007/06/28/10-steps-to-creating-a-fmea/.

APPENDIX A: FACILITIES AND EQUIPMENT:

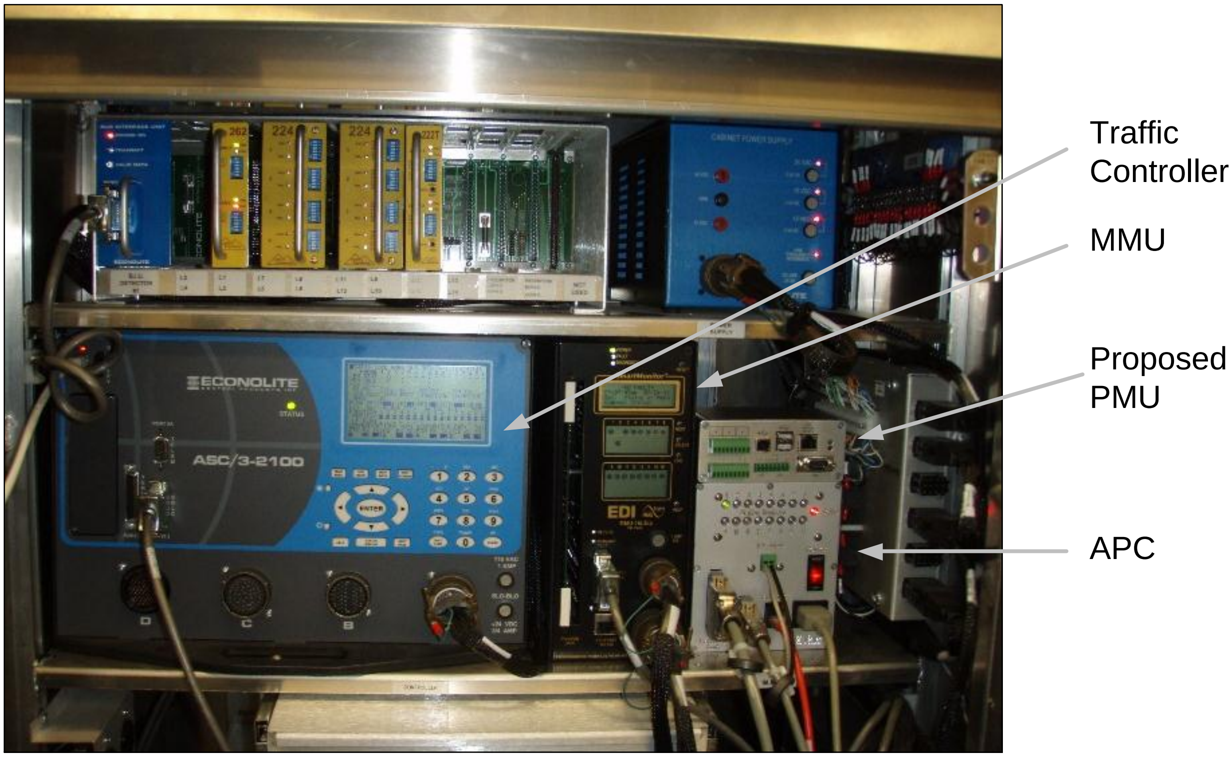

Figure 2. Picture of traffic controller cabinet

Figure 3. Proposed commercial off-the-shelf PFM hardware—top view

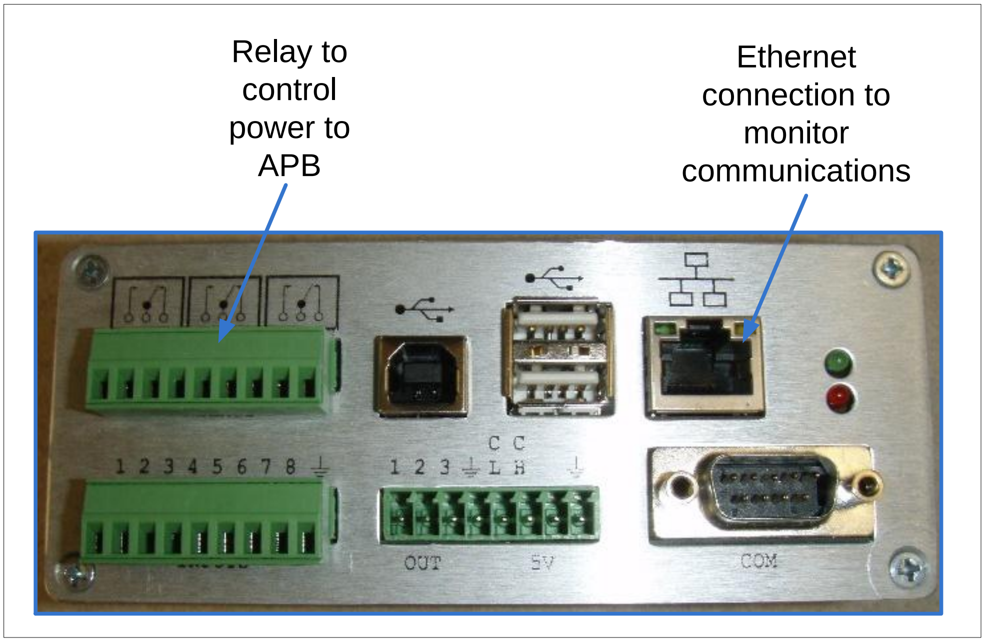

Figure 4. Proposed commercial off-the-shelf PFM hardware—back view showing interface connections to AAPS

Figure 5. Intersection at 6th and Deakin Streets, Moscow, ID

Figure 6. AAPS installation team at 6th and Deakin Street. Left: Zane Sapp, Campbell Company (former graduate student). Right: Cody Browne (current graduate student)

APPENDIX B: BIOGRAPHICAL SKETCHES AND INDIVIDUAL SUPPORT:

CURRICULUM VITAE
University of Idaho

NAME: Wall, Richard Wayne **DATE:** May 24, 2011
RANK OR TITLE: Professor of Electrical Engineering
DEPARTMENT: Electrical and Computer Engineering
OFFICE LOCATION AND CAMPUS ZIP: 203 Gauss-Johnson, 1023
OFFICE PHONE: (208) 885-7226
FAX: (208) 885-7579
EMAIL: rwall@uidaho.edu
DATE OF FIRST EMPLOYMENT AT UI: August 1, 1990
DATE OF TENURE: July 1, 1996
DATE OF PRESENT RANK OR TITLE: July 1, 2006

EDUCATION BEYOND HIGH SCHOOL:

Degrees:
Ph.D., Electrical Engineering, University of Idaho, Moscow, Idaho, 1989, EE
M.Engr., Electrical Engineering, University of Idaho, Moscow, Idaho, 1980, EE
B.S., Electrical Engineering, Pennsylvania State University, University Park, Pennsylvania, 1968, EE
Certificates and Licenses:
Professional Registration: State of Idaho Professional Engineer Registration Number 3271

EXPERIENCE:

Teaching, Extension and Research Appointments:
August 2000-present, Associate Professor, Electrical and Computer Engineering, University of Idaho
August 1997-July 2000, Associate Professor, Electrical Engineering, University of Idaho
August 1996-July 1997, Associate Professor, Electrical Engineering, University of Idaho (at Boise)
1990-July 1996, Assistant Professor, Electrical Engineering, University of Idaho (at Boise)
1988-90, Affiliate Faculty, University of Idaho, Engineering Education in Boise Program

Academic Administrative Appointments:
August 1997-June 1999, Director, Computer Engineering Program, University of Idaho

Non-Academic Employment, Including Armed Forces:
1985-90, Senior Development Engineer over Test and Development Group, Distribution Engineering Department, Idaho Power Co., Boise, Idaho.
1977-85, Engineer III for Protective Relay Group, Substation Engineering Department, Idaho Power Co., Boise, Idaho.
1973-77, Engineer II in Communications Department, Idaho Power Co., Boise, Idaho.
1968-73, USAF, Repair and calibration of electronic test equipment and avionics.

Consulting:
1990-99, Principal Owner of Northwest Signals and Systems. Area of expertise:

- Communications, instrumentation, and control system design employing embedded controllers for transportation and robotics applications.
- Simulation of power system electrical transients using an electromagnetic transient program for personal computers. This program was developed as an integral part of Ph.D. research and is commercially marketed.
- Analog and digital signal processing, filtering, and automated control.

Short Courses:
1999, R. Wall "High level language programming in microcontroller design" Advanced Input Devices.
1999, B.K. Johnson, and R.W. Wall, "EMTP and Power System Modeling," Schweitzer Engineering Laboratories.
1994, B.K. Johnson, and R.W. Wall, "Fundamentals of TACS," Idaho Power Company and Schweitzer Engineering Laboratories.
1994, B.K. Johnson and R.W. Wall, "Synchronous Machine Modeling with EMTP," Idaho Power Company and Schweitzer Engineering Laboratories, Pullman, Washington.
1992, R.W. Wall, and J.N. Peterson, "Digital Signal Processing for Power System Protection," Idaho Power Co., Boise, Idaho.
1991, R.W. Wall, "Fundamentals of EMTP," Idaho Power Co., Boise, Idaho.
1991, J.N. Peterson and R.W. Wall, "Fundamentals of Digital Control," EG&G, Idaho Falls, Idaho.

Industry Consulting:
June 2003-August 2003, LEA International, Hayden Lake, Idaho, Status Monitor for Industrial MOV Transient Suppression Systems.
May 1999-August 2000, Schweitzer Engineering Labs, Pullman, Washington: Writing New Text – *Power System Protection.*
June-August 1998, Schweitzer Engineering Labs, Pullman, Washington: EMTP study of 500KV transmission system in Brazil.
August 1997, Mobile Computing Corporation, Toronto, Canada: Developed 12VDC power line carrier network communications for advanced front end loader with CEBus technology.
June 1996, Simplot R&D Chemical Division, Pocatello, Idaho: developed controller code for commercial center pivot using Echelon 480VAC communications for networking on center pivot irrigation systems.
June-August 1994, Schweitzer Engineering Labs, Pullman, Washington. Work responsibilities: Research project investigating the opportunities for efficient power system instrumentation using networked protective relays. The study identified computational and hardware requirements for real-time instrumentation and control for power system protection.
June-August 1993, Power Engineers, Hailey, Idaho. Work responsibilities: Power system transient study to determine insulation requirements for a new 345KV - 90 mile transmission line. The study determined the maximum transient voltage at predetermined points on the transmission line by switching operations. The analysis

was based upon the statistical results of 1600 simulations using a transient analysis program that I developed as part of my Ph.D. research.

June-August 1992, ARAGO Robotics Inc., Anchorage Alaska. Work responsibilities: Design of a six axis robot with one axis position feedback using an Intel i80C196KD processor. Design responsibilities included development of a real-time operating system for the 80C196, hardware design of the processor board and design of the multiprocessor protocol.

June-August 1991, Mobile Computing Company, Toronto, Canada. Work responsibilities: Design of an 8051 controller for aircraft fuel delivery and on-site billing system.

TEACHING ACCOMPLISHMENTS:

Areas of Specialization:

Embedded computing, distributed sensor networks, digital filtering, digital control, power system protection, electrical transients, capstone design

Courses Taught:

ECE 240 Digital Logic, Sp06
ECE 340 Microprocessors, F03, F04-Sp05, Sp06-S10
ECE 341 Microcontrollers Lab, F03, F04, Sp07, Sp08
ECE 443 Distributed processing and Embedded Networks F05, F06, F07, F08, F09, F10
ECE 476 S09, S10
ECE 471 Digital Control Systems, F05, S07
ECE 482 Senior Design I for COE, F03
ECE 483 Senior Design II for COE, Sp04
ECE 499 Advanced Microcontrollers Sp06
ECE 504 Digital Signal Processors, Sp09
ECE 526 Power System Protection II, Sp05(V)
ECE 599 Advanced Microcontrollers Sp06
EE 404 Embedded Control, Sp01(V), Sp04
EE 301 Linear Systems Theory, Sp88
EE 320 Electric Machinery, Sp91
EE 340 Introduction to Digital Logic, Sp94
EE 443 Embedded Micro-Controllers, F90-98, F01 and F02
EE 470 Control Systems, F91
EE 476 Digital Filtering and DSP, Sp92, Sp02(V), Sp09
EE 480 Senior Design I, F88, F90-96, F98, F00, and F02
EE 481 Senior Design II, Sp89, Sp90-97, Sp01-F01, and Sp03
EE 499 Distributed Control for Cooperative Autonomous Vehicles, Sp03
EE 504 Power System Transients - EMTP, Su91(V)
EE 504 Special Topics, System Identification, Sp93(V)
EE 504 Advanced Embedded Microcontrollers, Sp94, F96, Sp02, Sp04
EE 504 Distributed Processing and Control Networks, Sp97, S99
EE 504P Advance Power System Protection, Sp03(V)
EE 504 Digital Signal Processors, Sp09
EE 525 Power System Relaying, F00(V)

Students Advised:

Undergraduate Students:
30 computer and electrical engineering students

Graduate Students Advised to Completion of Degree:

Ph.D. Dissertation Supervised:

Jody Gambles, "Design for Advanced VLSI Fault Simulation," Ph.D., 1996.

Dave Whitehead, in progress, expected graduation date – 5/2010

Master Thesis Supervised:

Zane Sapp, "Real Time Network Control for Advanced Accessible Pedestrian Systems Using Ethernet Over Power Line" University of Idaho, August 2010

Craig Craviotto, "Pedestrian Station Design using Distributed Real-Time Processing", University of Idaho, June, 2010

Gabriel DeRuwe, "Smart Signals Pedestrian Controls for the Vision Impaired", University of Idaho, May, 2009

Dustin DeVoe, "Application of Intelligent Transportation System Protocols for Controlling a Distributed Network of Advanced Traffic Devices", University of Idaho, May, 2009

Sanjeev Giri, "Application of a Safety Critical Network For Distributed Smart Pedestrian Signals in a Road Traffic Intersection System", Master Science in Computer Engineering, University of Idaho, January 2008

Andrew Huska, "Application of Plug and Play Distributed Sensor Networks to Traffic Control Signals," Master Science in Computer Engineering, University of Idaho, May 2006

Troy Cuff, "A Communications Interface for Configuration and Control Management in Fleets of Autonomous Vehicles," MS COE 2006

Aghogho Ekpruke, "Design Methodology and Performance Evaluation of IEEE 1451.2 Plug and Play Instrumentation and Control Networks," MS COE 2003.

Randy Reeder, "Kalman Filtering applied to Optimal Irrigation," MSEE, 2002.

Kevin Thompson, "Fuzzy Logic Control of Bi-Phase Induction Motors," MSEE, 1995.

James Patrick Wiggins, "Real-Time Simulation of Transformers Including Nonlinear Characteristics," MSEE, 1994.

Masters of Engineering Supervised to completion:

Jeff Vicario, Jianqiang Zeng, Laura Watson, Daniel Johnson, David Duhadway, Dan Wermers, Adam Johnson, Chris Atkins, Van Truong

Master Thesis Supervised in progress:

Cody Browne, "Linux based distributed processor for Advance Accessible Pedestrian Signals", expected graduation date – 5/2012

Eugene Bordenkircher, "Hardware in the Loop Testing of Traffic Controllers," in progress, expected graduation date – 5/2010

Graduate Students Served as Committee Member:

PhD Committee Member:

David Buehler

Master of Science Committee:

Corry Thuen, Truong Van, Joel Alberts, Douglas Welling, Michael Hoyt, Manjunatha Reddy-Jayarama, Mike Staihar, Mark Hurst, Ojas Dharia, Jon Christopherson, Akira Okamoto, Thomas A. Bean, Bradley N. Baker

Master of Engineering:

David Hebert, Miguel Moreno, Jennifer Westburg, Cody Krogh

Materials Developed:

Microcontrollers laboratory for the Cypress PSoC mixed signal processor (2008)
Microcontrollers laboratory for the Rabbit Semiconductor 3000 processor (2004)
CD based short course for microprocessor development CAD tools, 2002

Courses Developed:

2009, Added Analog Devices ADSP 21364 digital signal processor lab experiments to ECE 476.

2004, Junior level microcontrollers course with lab ECE 340 and 341 centered on new microprocessor. Designed a new microprocessor project system using UI teaching and Learning grant.

2003, Distributed Processing for Networked Based Embedded Systems; new course for ECE 443

2002, Added DSP laboratory to EE476 and designed experiments for off-campus students using PC based instrumentation and WEB based instruction.

2002, Developed distance education hardware based lab for Digital Filtering Course EE 476.

1997, Developed a distributed processing and control networks laboratory for the CAN I^2C, AccNet, CEBus, and Echelon Real-Time control networking technologies.

1996, Developed an advanced microcontroller laboratory that focuses on networked distributed embedded control and high speed embedded processing using RISC and DSP processors. Processors include, i860, i960, TI DSP320C50, AT&T DSP32C, SMC COM20051, i80C196MD, i80C196CA, and i80C196KR.

1994, Developed laboratory equipment for power electronics laboratory with senior design students.

1992, Specified and supervised the acquisition of laboratory equipment for an expanded digital laboratory. Developed new laboratory manual for an advanced course in embedded microcontrollers.

1992, Supervised the construction of a new senior design laboratory. Facilitated the acquisition of laboratory test equipment and computer resources for design activities.

1990, Supervised the construction of a new undergraduate power laboratory. Solicited industry and professional society financial contributions to offset construction costs. Facilitated the acquisition of laboratory machinery and instrumentation. Developed a new laboratory manual for the undergraduate machinery course.

1990, Implemented EE443 on embedded microcontrollers that included laboratory exercises as an integral part of the course. Developed laboratory experiments based on demonstration hardware and software. Secured donations for partial construction funding from industry and professional organizations.

Non-credit Classes, Workshops, Seminars, Invited Lectures, etc.:

2002, "C from A to Z," Robert Rinker and Wall, R.W., 3 hour tutorial on fundamentals of C programming.

SCHOLARSHIP ACCOMPLISHMENTS:

Publications:

Refereed Journals:

King, B.A., R.W. Wall, T.W, Winward, and D.L. Bjorneberg,"Collector Design for Measuring High-Intensity Time Variant Sprinkler Application Rates" *Journal of Applied Engineering in Agriculture*, Vol. 25, No. 1, 2010, pp.85-95.

King, B.A., R.W. Wall, and J.P. Taberna. "Center-Pivot Irrigation System for Independent Site-Specific Management of Water and Chemical Application," *Journal of Applied Engineering in Agriculture*, Vol. 25, No. 5, 2009, pp.677-683.

DeVoe, D.*, S. Giri*, and R.W. Wall, "A Distributed Ethernet Network of Advanced Pedestrian Signals", Transportation Research Board Record, Washington, DC, 2009, Access # 01125542, Report # 09-3256

King, B.A., R.W. Wall, and T.F. Karsky. "Center-Pivot Irrigation System for Independent Site-Specific Management of Water and Chemical Application," *Journal of Applied Engineering in Agriculture*, Vol. 25, No. 2, 2009, pp.187-198.

Giri, S. and R.W. Wall, "A Safety Critical Network for Distributed Smart Signals" IEEE Instrumentation and Measurement Magazine, Vol. 11, No. 6, December 2008, pp 10-16.

King, B.A., J.C. Stark, and R.W. Wall. "Comparison of Site-Specific and Conventional Uniform Irrigation Management for Potatoes," *Journal of Applied Engineering in Agriculture*, Vol. 22, No. 5, 2006, pp.677-688.

King, B.A., and R.W. Wall. "Field Testing of a variable Rate Sprinkler and Control System for Site Specific Water and Nutrient Application," *Journal of Applied Engineering in Agriculture*, Vol. 21, No. 5, 2005, pp.847-843.

King, B.A., and R.W. Wall, "Distributed Control and Data Acquisition System for Closed-Loop Site Specific Irrigation Management with Center Pivots," *Journal of Applied Engineering in Agriculture*, Vol. 21, No. 5, 2005, pp.871-878.

Wall, R.W. and B.A. King, "Network Protocol for Multi-Media Ad Hoc Data," *Journal of Applied Engineering in Agriculture*, Vol. 21 No. 2, 2005, pp.285-293.

King, B.A., R.W. Wall and J.P. Taberna, Jr. 2001. Visual Soil Water Status Indicator for Improved Irrigation Management. *Computers and Electronics in Agriculture* Vol. 32:31-43.

King, B.A., and R.W. Wall. "Distributed Instrumentation for Optimum Control of Variable Speed Electric Pumping Plants with Center Pivots." *Journal of Applied Engineering in Agriculture.* Vol. 16 No. 1, July 2000, pp. 45-50.

King, B.A., and R.W. Wall. "Supervisory Control and Data Acquisition System for Site-Specific Center Pivot Irrigation," *Journal of Applied Engineering in Agriculture*, Vol. 14(No. 2, 1998, pp. 135-144.

Wall, R.W., and H.L. Hess. “Design of Microcontroller Implementation of a Three Phase SCR Power Converter,” *Journal of Circuits, Systems, and Computers*, Vol. 6, No. 6, March 1997, pp. 619-633.

Wall, R.W., and B.J. Johnson. “Using EMTP and TACS to Teach Protective Relaying Fundamentals.” *IEEE Transactions on Power Delivery*, Vol. 12, No. 1, February 1997, pp. 3-10.

Peterson, J.N., and R.W. Wall. “Interactive Relay Controlled Power System Modeling.” *IEEE Transactions on Power Delivery*, Vol. 6, No. 1, January 1991, pp. 96-102.

Peterson, J.N., and R.W. Wall. “Cooperative Engineering Design Class Program for Industry and Universities.” *IEEE Transactions on Power Systems*, Vol. 4, No. 1, February 1989, pp. 368-371.

Refereed Conference Papers:

DeVoe, D.*, S. Giri*, and R.W. Wall, “A Distributed Ethernet Network of Advanced Pedestrian Signals”, The 88th Annual Meeting of the Transportation Research Board, Washington, DC, January 11-15, 2009, Paper # 09-3256

DeRuwe, G.* and R. W. Wall, “Pedestrian Navigation and Integration with Distributed Smart Signal Traffic Controls ”, The 34th Annual Conference of the IEEE Industrial Electronics Society, Orlando, FL, November 11, 2008, Paper # HD-010979

DeVoe, D*. and R.W. Wall, “A Distributed Smart Signal Architecture for Traffic Signal Controls”, 2008 IEEE International Symposium on Industrial Electronics, Cambridge, UK, July 2, 2008 , paper #004928

Wall, R.W., T. Urbanik, D. Bullock, S. Allen*, M. Busby*, D. DeVoe*, A. Huska*, T. Rallens* “Distributed Traffic Signal Control: Improving Pedestrian Control as A First Step”, Transportation Research Board 2007 Annual Meeting, Washington D.C. January 21-25, 2007, Paper No. 07-0989

Wall, R.W., A. Huska*, and D. Bullock, “Application of Plug and Play Distributed Signal Technology to Traffic Signals,” Transportation Research Board 2006 Annual Meeting, Washington D.C., January 22-26, 2006, Paper No. 06-2728.

Wall, R.W. and A. Huska*, “Design Platform for Plug-and-Play IEEE 1451 Traffic Signal,” The 31st Annual IEEE Industrial Electronics Conference, Raleigh, NC, Nov 6-10, 2005, Paper No. RD-001973.

Mynam, M.V.*, R. Nelson*, R.W. Wall, and B.K. Johnson, “Stochastic Approach For Modeling Arcing Faults In Cables From Experimental Data,” Proceedings of the 2005 International Conference on Power Systems Transients (IPST 2005). Montreal, Quebec, Canada, Paper No. IPST05-123-18c, June 19-23, 2005.

Wall, R.W. and B.A. King, “Field Experiences with Power Line Carrier of Automated Sprinkler Control for Precision Agriculture,” 9th Annual Symposium on Power-Line Communications and Its Applications, April 6-8, 2005, Vancouver, Canada. pp 109-115.

Li, Z., B.J. Johnson, A. Abdel-Rahim, R.W. Wall, and M. Kyte, “An Automated Tool to Test the Functionality of a Traffic Signal Controller Functionality,” 84th Annual Meeting of the Transportation Research Board, Washington DC, January 9-13, 2005, paper No. 05-2452.

Johnson, B.J., R.W. Wall, A. Abdual-Rahim, E.M. Suwal, T.R. Cuff, and B.E. Hammlett, “Modeling Advanced Traffic Signal Control Systems: A Communication Network Prototype,” IEEE conference on Intelligent Transportation Systems, October 2004.

Suwal, E.M.*, T.R.* Cuff, B.E.* Hamlett, B.K. Johnson, R.W. Wall, and A. Abdel-Rahim. "Modeling Advanced Traffic Signal Control Systems: A Communication Network Prototype," 2004 IEEE Intelligent Transportation Systems Conference, Washington, D.C., USA, October 3-6, 2004, pp 367-371.

Wall, R.W., and L.R. Wall, "Generating Verifiable Microprocessors State Machine Code with HDL Design Tools," IEEE IECON 03, Roanoke, Virginia, November 2-6, 2003, pp. 2441-2446.

Wall, R.W., "Simple Methods for Detecting Zero Crossing," IEEE IECON 03, Roanoke, Virginia, November 2-6, 2003, pp 2477-2481.

Wall, R.W., and A. Ekpruke*, "Developing an IEEE 1451.2 Compliant Sensor for Real-time Distributed Measurement and Control in an Autonomous Log Skidder," IEEE IECON 03, Roanoke, Virginia, November 2-6, 2003, pp. 2482-2487.

Wall, R.W. and B.K. Johnson, "Regenerative Train Control Networks for Gas Turbine Powered High-Speed Rail Locomotive with Flywheel Energy Storage" IEEE IECON'02, Sevilla, Spain, November 5-8, 2002.

Wall, R.W., J. Bennett*, K. Lichy, E. Owings*, and G. Eis, "Creating A Low Cost Autonomous Vehicle," Accepted for IEEE IECON'02 Sevilla, Spain, November 5-8, 2002.

Wall, R.W., and K. Belknap, "Capstone Design for Education and Industry: Past Graduates and Industry Perspectives," Session #1532, Proceedings of American Society of Engineering Education Annual Conference, Washington, D.C., June 23-26, 1996.

Hess, H.L., R. Rinker, R.W. Wall, J.N. Petersson, and K. Belknap, "Two-University Cooperation: Paradigm for the Future of Statewide Engineering Education." Proceedings of American Society of Engineering Education Annual Conference, Washington, D.C., June 23-26, 1996.

Wall, R.W., and B.K. Johnson, "Using EMTP and TACS to Teach Protective Relaying Fundamentals." *IEEE Power Engineering Society Transactions*, presentation at IEEE Power Engineering Society 1996 Winter Meeting, January 21-25, 1996, Baltimore, Maryland.

Wall, R.W., and T. Tibbals, "Design and Application of a Table-Top EMTP Test System," 17th Annual Western Protective Relay Conference, October 24, 1990, Spokane, Washington.

Wall, R.W., and J.N. Peterson, "Relay Modeling with a Computer Power System Transient Program," 15th Annual Western Protective Relay Conference, October 26, 1988, Spokane, Washington.

Conference Publications:

Biedler, G* and R. Wall, "Low Cost Distributed Control System for Autonomous Vehicles", IEEE Oceans '06 Asian Pacific, Singapore, May 17, 2006, Paper No. 060226-01

Cuff, T and R. Wall, "Support platform and Communications to Manage Cooperative AUV Operations", IEEE Oceans '06 Asian Pacific, Singapore, May 18, 2006, Paper No. 051221-04

King, B.A., J.C. Stark, and R.W. Wall. "Site-Specific Water And Nitrogen Management For Potatoes With Center Pivot Irrigation," 26th Annual International Irrigation Show, Phoenix, Arizona, November 6, 2005

King, B.A., J.C. Stark, and R.W. Wall, "Increased Gross Return from Site-Specific Water Management for Potatoes Under Center Pivot Irrigation," 2004 ASAE/CSAE Annual International Meeting, Ottawa, Ontario, Canada, August 1-4, 2004, Paper No.

Wall, R.W. and B.A. King, "Incorporating Plug and Play Technology into Measurement and Control Systems for Irrigation Management," 2004 ASAE/CSAE Annual International Meeting, Ottawa, Ontario, Canada, August 1-4, 2004, Paper No. 042189.

Ekpruke, A.* and R.W. Wall, "Low-Cost Sensor System for Alarm Reporting," North American Power Symposium, Moscow, Idaho, August 9-10, 2004, Paper No. MD-000011.

King, B.A., R.W. Wall, and J.P. Taberna, Jr., "New Proportional Chemical Injection System for Improved Chemigation Uniformity with Center Pivots," 2003 ASAE Annual International Meeting, Las Vegas, Nevada, July 27-30, 2003, paper number 032911.

D.C. Flegel*, R.O. Nelson, R.W. Wall, H.L. Hess, and B.K. Johnson, "An Analog Model Power System for Research and Classroom Use," North American Power Symposium 2003, Rolla Missouri, October 20-21, 2003.

Wall, R.W. and B.A. King, "Network Protocols for Efficient Distributed Control in Agriculture," 2002. ASAE Annual International Meeting / CIGR XVth World Congress, Hyatt Regency Chicago, Chicago, Illinois, July 28-July 31, 2002.

Mangapathirao, M.V.*, R. Nelson*, R.W. Wall, and B.K. Johnson, "Stochastic Approach For Modeling Arcing Faults In Cables From Experimental Data," North American Power Symposium 2002, Tempe, Arizona, October 14-15, 2002.

King, B.A., R.E. Reeder, R.W. Wall, and J.C. Stark, "Comparison of Site-Specific and Conventional Uniform Irrigation Management for Potatoes," 2002 ASAE Annual International Meeting / CIGR XVth World Congress, Hyatt Regency Chicago, Chicago, Illinois, July 28-July 31, 2002.

Wall, R.W. and B.A. King, "Network Protocols for Efficient Distributed Control in Agriculture," 2002ASAE Annual International Meeting / CIGR XVth World Congress, Hyatt Regency Chicago, Chicago, Illinois, July 28-July 31, 2002.

King, B.A., R.E. Reeder, R.W. Wall, and J.C. Stark, "Comparison of Site-Specific and Conventional Uniform Irrigation Management for Potatoes," 2002 ASAE Annual International Meeting / CIGR XVth World Congress, Hyatt Regency Chicago, Chicago, Illinois, July 28-July 31, 2002.

Wall, R.W. and B.A. King. "Tiered Networks," IECON'01 Proceeding of the 27th Annual Conference of the IEEE Industrial Electronics Society, Denver, Colorado, pp. 1816-1821, November 29-December 2, 2001.

King, B.A. and R.W. Wall, "Secondary, Spatially Variable Chemical Application System for Site-Specific Crop Management using Continuous-Move Irrigation Systems," St. Joseph, Michigan, July 30-August 1, 2001, ASAE Paper No. 01-2021.

King, B.A., R.W. Wall, and L.R. Wall. "Supervisory Control and Data Acquisition System for Closed-Loop Center Pivot Irrigation," ASAE Paper No. 00-2020, St. Joseph, Michigan, 2000.

King, B.A., J.P. Taberna, Jr., and R.W. Wall. "Field Evaluation of a Visual Soil Water Monitoring System," Presented at the 1999 Pacific Northwest Region Meeting of ASAE.

King, B.A. and R.W. Wall, "Center Pivot System Distributed Pressure Feed-Back Controller for Variable Rate Pumping Systems," Final Project Completion Report, Idaho Power Company, Boise, Idaho, 1998.

King, B.A., R.W. Wall, and J.P. Taberna, Jr., "Visual Soil Water Monitoring System for Improved Irrigation Management," ASAE Paper No. 98-2102, St. Joseph, Michigan, 1998.

Miller, A.A.*, W. Qian*, B.K. Johnson, J.D. Law, and R.W. Wall. "High Speed Locomotives with Energy Storage," North American Power Symposium, Bozeman, Montana, October 1997.

King, B.A., R.W. Wall, D.C. Kincaid, and D.T. Westermann, "Field Scale Performance of a Variable Rate Sprinkler for Variable Water and Nutrient Application," ASAE Paper No. 97-2216, St. Joseph, Michigan, 1997.

King, B.A. and R.W. Wall, "Digital Power Line Carrier Control System for Optimum Operation of Variable Speed Pumping Plants with Center Pivots," ASAE Paper No. 97-2191, St. Joseph, Michigan, 1997.

Wall, R.W. and B.A. King, "Center-Pivot Irrigation System Control and Data Communications Network for Real-Time Variable Water Application," *Proceedings of the 3rd International Conference on Precision Agriculture.* Robert, P.C., R.H. Rust and W.E. Larson (Eds.), ASA, Madison, Wisconsin, July 1996. pp. 757-766.

Hess, H.L., R.W. Wall, and D. Zattiero*, "A Microcontroller-Based Pulsed Width Modulated Voltage Source Inverter," North American Power Symposium, Bozeman, Montana, October 2, 1995.

Wall, R.W., "Capstone Design for Education and Industry," 57th Annual Conference, Pacific Northwest Section, American Society of Engineering Education, Boise, Idaho, April 20, 1995.

Wall, R.W. "Report on 80C196 Based Networked Controller Board," Morrison Knudsen, Inc., Internal Report, 1994.

Wall, R.W. "Analysis of Networked Distributed Power System Instrumentation of Protective Relaying," Schweitzer Engineering Laboratories Internal Report, 1994.

Wall, R.W., and B.K. Johnson, "Digital Filtering and Relaying," EMTP Tech Notes, Issue 94-4, October 1994, pp. 3-21.

Wall, R.W., "Sprinklers and Power Lines," IEEE Computer Applications in Power, Vol. 14, No. 2, April 2001, pp. 25-29.

Wall, R.W. "How to Increase Interrupts in an MCU Design," *Embedded System Programming*, January 2000, Vol. 13, No. 1, pp. 82-86.

Wall, R.W., and L.R. Wall*, "Microprocessor Implementation of PLD Designs," *Embedded Systems Programming*, January 1998, Vol. 11, No. 1, pp. 54-72.

Wall, R.W. "High Tech Pioneers." *Innovator*, Vol. 5, Number 2, Intel's Newsletter for the Academic Community, Summer 1992.

Wall, R.W. and J.N. Peterson. "TOC Relay Modeling with a Computer Power System Transient Program." Pennsylvania Electric Association Relay Committee Spring Meeting, May 31, 1990, White Haven, Pennsylvania.

Conference Presentations:

Wall, R. W. "Education for Advanced Technologies" Transportation Research Board Traffic Signals Subcommittee Meeting, Moscow, ID, July, 19, 2010

Wall, R.W. “Traffic Signal Technology Innovations”, 2010 Road Builders Clinic, Coeur d’Alene, ID, March 3, 2010

Wall, R.W. “Advanced Accessible Pedestrian Signals Research”, Palouse Chapter of IEEE, Moscow, ID, January 22, 2009

Wall, R.W. “Advances in Pedestrian Signals”, Penn State Transportation Engineering and Safety Conference, State College, PA, December 10th, 2008

Wall, R.W., “Smart Signals Technology”, Rocky Mountain Chapter of the Association for Education and Rehabilitation of the Blind and Visually Impaired, Idaho Falls, ID, October, 1, 2008

Wall, R.W., “Countdown Pedestrian Signals & Role of Power line Carrier”, International Municipal Signal Association Northwest Section 2008 Conference, Richland, WA., September 17, 2008

Wall, R.W., “Smart Signals Research at the University of Idaho, Road Builders Clinic”, Coeur d’Alene, ID, February 2007.

Wall, R.W., “Smart Signals, ATS America – Japan Seminar”, Washington D.C., January 2007.

King, B.A., J.P. Taberna, Jr., and R.W. Wall, “Field Evaluation of a Visual Soil Water Monitoring System,” The Pacific Northwest Region Meeting of ASAE and CSAE, Sherwood Hills Resort, Logan, Utah, 1999.

King, B.A., J.C. Stark, and J.P. Taberna, Jr., “In-Season Spatial Variability of Potato Petiole Nitrogen,” The 4th International Conference on Precision Agriculture. St. Paul, Minnesota, 1998.

King, B.A., R.W. Wall, and J.P. Taberna, Jr., “Visual Soil Water Monitoring System for Improved Irrigation Management,” The ASAE Annual International Meeting. Orlando, Florida, 1998.

Wall, R.W., “Agricultural Irrigation System Control and Data Communications Network for Real-Time Variable Water Application,” LonUsers 11th International Conference, San Jose, California, May 1997.

Patents:

Tate, P., R.W, Wall, G. DeRuwe, and C. C Craviotto, “Advanced Accessible Pedestrian System for Signalized Traffic Intersections”, provisional patent filed, August 27, 2008.

Wall, R.W. and G. DeRuwe, “Advanced Accessible Pedestrian Control System for the Physically Disabled”, U.S. Patent Application No. 12/411,306, March 25, 2009.

Wall, R.W. and A. Huska, “Plug and Play Traffic Signals,” Patent Application Docket No. 05-018-1/1079 filed on July 8, 2005, Patent Application, July 7, 2006.

Grants and Contracts Awarded:

Wall, R.W. (PI), Networked Accessible Pedestrian Signals - extended, Campbell Company, Boise, ID., September 2010 through December, 2011. $61,667

Wall, R.W. (PI), (90%), and B.K. Johnson, “Smart Signals Countdown Pedestrian Signal”, USDOT UTC, August 2010-August 2011, $124,633.

Wall, R.W. (PI), (80%) , M. Kyte, and B.K. Johnson, “Closed Loop Operation of Network Based Accessible Pedestrian Signals”, USDOT UTC, August 2009-August 2010, $111,723.

Wall, R.W. (PI), Networked Accessible Pedestrian Signals, Campbell Company, Boise, ID., September 2008 through August 2009. $60,520

Frenzel J.(PI), R.W Wall, (45%) , and B.K. Johnson, "Commercialization and Field Distribution of Smart Pedestrian Call Signals", USDOT UTC, August 2008-August 2009, $117,357.

Abdel Rahim, A. and R.W. Wall, An Automated Testing Tool for Traffic Signal Controller Functionalities, Idaho Transportation Department, Boise ID, Jan. 9 2008 through Feb. 15, 2009, $49,246.

Wall, R.W. (PI), J.F. Frenzel, "Advanced Interactive Signals for Able-bodied and Disabled Pedestrians", Idaho State Board of Education Higher Education Grant, January 2008 through December 2008, $75,000.

Edwards, D, M. Anderson and R.W. Wall (10%), M. O'Rourke, J. Frenzel, T. Soule, "Developing Vision Systems for an Autonomous Forest Vehicle", Idaho State Board of Education Higher Education Grant, January 2008 through December 2008, $75,000.

Edwards, D, M. Anderson and R.W. Wall (15%), M. O'Rourke, J. Frenzel, T. Soule, " Magnetic Signature Assessment System using Multiple Autonomous Underwater Vehicles", Office of Naval Research, Grant # N00014-08-1-0799, April 2008 through April 2009, $1,425,100.

Edwards, D, M. Anderson and R.W. Wall (16%), M. O'Rourke, J. Frenzel, " Cooperative Autonomous Underwater Vehicles used to Search Large Ocean Areas for Mines", Office of Naval Research, Grant # N00014-08-1-0799, February 2008 through July 2009, $456,400,000.

Wall, R.W (PI) , J. Frenzel and B.K. Johnson, "Pilot Deployment of PnP Smart Traffic Signals Phase II," NIATT, USDOT UTC, August 2007-August 2008, $81,000.

Wall, R.W. (PI), J.F. Frenzel, and B.K. Johnson, "Street Deployment of Pedestrian Control Smart Traffic Signals," NIATT, USDOT UTC, August 2007-August 2008, $93,707.

Wall, R.W (PI) and B.K. Johnson, "Conflict Monitor for Plug and Play Distributed Smart Signals and Sensors for Traffic Controllers," NIATT, USDOT UTC, August 2006-August 2007, $100,000.

Wall, R.W (PI) and B.K. Johnson, "Full Scale Implementation of Plug and Play Smart Traffic Signal and Pedestrian Wait/Walk Display with PED button," NIATT, USDOT UTC, August 2005-August 2006, $9,000.

McCann, I., B. Felton, B.A. King, R.W. Wall, and J. Starr, "Conserving Water and Nitrogen by Using New Sensor, Control Systems and Information Technology to Improve O-farm Irrigation Scheduling in the Delmarva Peninsula," Natural Resources Conservation Service, September 2005-August 2008, $46,333. (Wall portion $13K).

Wall, R.W. (PI), B.K. Johnson, and D. Bullock, "Plug and Play (PnP) Smart Sensor Traffic Signals System," NIATT, USDOT UTC , June 2004-June 2005, $99,556.

Edwards, D, M. Anderson and R.W. Wall, "Developing Fleets of Autonomous Underwater Vehicles," Office of Naval Research, April 2005-March 2006, $1,370,036(Wall portion – 25%).

Edwards, D, M. Anderson and R.W. Wall, "Fabrication of a Fleet of Mini-AUVs," Office of Naval Research, September 2004-August 2005, $65,000 (Wall portion – 65%).

Edwards, D., M. Anderson and R.W. Wall, "Communications and Control Fleet of Autonomous Underwater Vehicles," Office of Naval Research, April 2004-May 2005, $730,855 (Wall portion – 25%).

Feeley, J., D. Edwards, M. Anderson, and R.W. Wall, "Decentralized Control of Multiple Autonomous Underwater Vehicles," Office of Naval Research, June 2003-May 2005, $880,000 (Wall portion – 15%).

Feeley, J., D. Edwards, M. Anderson, and R.W. Wall, "Decentralized Control of Multiple Autonomous Crawlers and Swimmers," Office of Naval Research, May 2003-April 2004, $374,573 (Wall portion – 10%).

Johnson, B.K., and R.W. Wall, "Remote-Access Hardware-in-the-Loop Simulation Lab," University Transportation Centers Program, Research and Special Programs Division, U.S. Department of transportation, August 2002-July 2003, $55,189.

Wall, R.W.(PI) and Johnson, B.K. "Model Real-Time Highway Traffic Control System," University Transportation Centers Program, Research and Special Programs Division, U.S. Department of Transportation, September 1, 2002-August 31, 2003, $44,107**.**

Johnson, B.K., and R.W. Wall, "Next Generation Controller Interface Device Development," University Transportation Centers Program, Research and Special Programs Division, U.S. Department of transportation, September 1, 2002-August 31, 2004, $97,474 .

Wall, R.W.(PI) and B.K. Johnson, "Model Real-Time Highway Traffic Control System," University Transportation Centers Program, Research and Special Programs Division, U.S. Department of transportation, September 1, 2002-August 31,2003.

King, B.A., J.C. Stark, and R.W. Wall, "Conjunctive In-Season Water & Nitrogen Management for Improved Production Efficiency," USDA-CREEES, September 1, 2002-August 31, 2004, $156,000 (Wall portion 20%).

Johnson, B.K. and R.W. Wall, "Fault Impedance Analysis," Office of Naval Research through DDL Omni Engineering, June-December 2002, $12,279 (Wall portion 90%).:

Johnson, B.K. and R.W. Wall, "Fault Impedance Modeling," Office of Naval Research through ANTEON Corporation, January-May 2002, $16,147 (Wall portion 60%).

Johnson, B.K., H.L Hess, and R.W. Wall, "Protection and Configuration of Zonal Distribution Systems," DoD EPSCoR, Office of Naval Research, April 1, 2000-March 31, 2003, $332,895 (Wall portion 10%).

Wall, R.W. (PI) and J.F. Frenzel, "Communications for Bore Hole Probe," Bechtel BWXT, Idaho, LLC, June-December 2001, $20,258.

Wall, R., "Spent Nuclear Fuel Containment Vessel Monitor, Phase II," Bechtel BWXT, Idaho, LLC, January-July 2001, $20,798.

Wall, R.W. (PI), "Spent Nuclear Fuel Containment Vessel Monitor," Bechtel BWXT, Idaho, LLC, May-September 2000, $24,946.

Wall, R.W. (PI), "Develop Protective Relaying Education Program," Schweitzer Engineering Labs, Research Center, 1999, $27,566.

King, B.A., R.W. Wall, and J.C. Stark, "Closed Loop Precision Irrigation for Improved Water Management," USDA NRICGP. September 1, 1999-August 31, 2001, $98,000 (Wall portion 50%).

King, B.A., R.W. Wall, and J.C. Stark, "Closed Loop Precision Irrigation for Improved Water Use Efficiency," USDA CSREES NRICGP. September 1, 1998-August 31, 1999, $10,120 (Wall portion 50%).

Wall, R.W. (PI), J.D. Law, B.K. Johnson, and J.N. Peterson., "Intelligent Power Management System," Morrison Knudsen Company, Federal Railroad Administration, November 6, 1995-May 2, 2002, $309,843.

King, B.F., and R.W. Wall., “Control Network for Variable Irrigation Management,” Precision Irrigation System Grant, 1995, $33,500.
Wall, R.W. “Functional Testing of Automatic Train Interface Controller and Automatic Station Interface Controller,” Morrison Knudsen Company, 1995, $24,170.
Wall, R.W. (PI), and B.F. King. “Precision Irrigation Control Systems, Inc. (PICS),” Small Business Innovation Research, 1995, $9,000.
Wall, R.W. “Performance Analysis of two 80C196xx Processors,” Preco, Inc., 1995, $566.
Wall, R.W. “Distributed Rail-Systems Instrumentation and Control,” Morrison Knudsen Company, 1993, $78,230.

Internal Grants Awarded:
Wall, R.W., University of Idaho Small Travel Grant, December 2004, $900.
Wall, R.W., “Low Cost Platform for an ‘Anywhere’ Microcontroller laboratory,” Teaching and Learning Grant, University of Idaho Vice Provost for Academic Affairs, May 2003-May 2004, $2,200.
Wall, R.W. University of Idaho Small Travel Grant, 1996, $900.
Hess, H.L., and R.W. Wall. “Using EE480 Senior Design projects to develop power-electronic converters for hands-on investigation,” University of Idaho Teaching/Learning Mini-Grant, 1994, $2,000.
Wall, R.W. “Analysis of Computational Requirements for Interactive Real-Time Powers Systems Simulation,” Research Council Seed Grant, 1992, $6,000.

Research Equipment Grants:
Wall, R.W., “i80C196 “C” programming integrated development environment software for W95 for the Embedded microcontroller laboratory,” IAR Systems software donation, 1997, $16,452.
Wall, R.W., “CEBus Cbench development system for IS60 power line carrier networks residential and commercial building automation,” Intellon Corporation donation, 1997, $7,391.
Wall, R.W., “Research grant for EV80C196MD Evaluation Embedded Microcontroller systems to investigate variable speed AC Drives. Intel Corporation,” Research and Laboratory Equipment Grant, 1993, $4,200.
Wall, R.W., “Student Travel Grant for Pat Wiggins to attend the IEEE PES 1992 Summer Meeting,” Power Engineers, $500; National Science Foundation, $610.
Wall, R.W., “Three i960 High Speed Embedded Processor Evaluation Systems for high speed transformer simulation,” Intel Corporation, Research and Laboratory Equipment Grant, 1992, $8,380.
Wall, R.W., “In-Circuit Emulator replacement parts,” Intel Corporation, Research and Laboratory Equipment Grant, 1991, $2,400.
Wall, R.W., “Two 80C196KC Microcontroller Development Systems and development software for use in EE480/481 and EE443,” Intel Corporation, Research and Laboratory Equipment Grant, 1991, $10,600.

Donations:
Wall, R. W., Cypress Microprocessor Development systems, Cypress Corporation, November 2008, $15,511.50.

Wall, R.W., Power System Relay Lab Equipment, Schweitzer Engineering Labs, July 2002, $3,730.
Wall, R.W., Power System Relay Lab Equipment, Schweitzer Engineering Labs, May 2002, $32,690.
Wall, R.W., ADSP 21065L Digital Signal Processing Development Equipment and Software, Analog Devices, December 2001, $9,660.
Wall, R.W., Power System Relay Lab Equipment, Schweitzer Engineering Labs, July 2000, $49,672.
Wall, R.W., Education donation of EV80C246-50 Evaluation Microcontroller systems hardware and software for use in Advanced Microcontrollers Course, Intel Corp. Research and Laboratory Equipment Grant, 1997, $5,000.
Wall, R.W., Education donation of EV80C196KD-20 Evaluation Embedded Microcontroller systems hardware and software for use in the undergraduate senior design course. Intel Corporation, Research and Laboratory Equipment Grant, 1997, $3,950.
Wall, R.W., DSP320C3x evaluation system for teaching DSP processing in advanced microcontroller class. Texas Instruments, 1996, $600.
Wall, R.W., Morrison Knudsen Company, donation, laboratory instrumentation equipment, 1994. Fluke Scope Meter, $1,985.
Wall R.W., John Fluke Manufacturing Company, donation, laboratory instrumentation equipment, 1994, $15,345.
Wall, R.W., EV80C196KD and EV80C196KR embedded microcontroller systems for support of the networking embedded microcontroller research and the advanced embedded control classes. Intel Corporation, Research and Laboratory Equipment Grant, 1994, $3,925.
Wall, R.W., Embedded microcontroller hardware and software for use in the undergraduate embedded controller course. Intel Corporation, Research and Laboratory Equipment Grant, 1993, $25,740.
Wall, R.W., John Fluke Manufacturing Company, Research and Laboratory Equipment Grant, 1993, $4,113, laboratory test equipment and instrumentation.
Wall, R.W., Intel Corporation, donation, technical literature, 1992, $1,497. Course material for EE443.
Wall, R.W., Hewlett Packard Corporation, donation, manufacturing and instrumentation equipment, 1991, $196,812.

Industry Sponsored Senior Design Projects:
Wall, R.W., Southwest Idaho Chapter of IEEE, donation, power and machines laboratory development, 1991, $1,000.
2003-04: Advanced Input Devices sponsored two projects for membrane keyboard cover testing and wireless audio streaming for dictation.
2003-04: Microsoft Corporation: Demonstration of Home Automation using MS-SCP, $3,000 (est.) equipment grant.
2002-03: Advanced Input Devices sponsored two projects: prototype for a motionless joy stick (joint ME – ECE) and wireless keyboard. $5,000 cash grant.
2002-03: Manning Applied Technology: FT-IR Spectronomy Controller.
1996-97: Micron Semiconductor sponsored project for the design of a portable DRAM Identification Reader for interrogating DRAM production codes. $3,254 cash grant.

1996-97: McCallaster Engineering sponsored project for the design and testing of a Kelvin Probe device to measure the work function of materials. $1,250 cash grant.
1995-96: J. R. Simplot Mineral and Chemical Group Research and Development sponsored project for developing a model that demonstrates spatially variable agricultural irrigation systems using networked power line carrier communications.
1994-95: Santa Clara Plastics sponsored project designing a state-space control system for coupled fluid controls. $5,000 equipment grant.
1994-95: Idaho Power Company sponsored project for developing a distribution automated control of VAR compensation on utility distribution lines using substation monitoring for local optimization and EMS communications for area wide optimization. $1,000 cash grant.
1994-95: Preco, Inc. sponsored project developing a precision agriculture embedded controller using J1939 (CAN) networked tractor-implement communications. $4,000 cash grant.
1993-94: Morrison Knudsen Company sponsored adjustable speed drive for a three phase, 2 HP induction motor using an Intel i80C196MD processor.
1993-94: Morrison Knudsen Company sponsored project investigating power-line carrier applications to rail-systems communications.
1993-94: Idaho Power Company sponsored project for developing a power factor monitor for predicting power insulator bushing failures. $850 cash contribution.
1991-92: Idaho Power Company sponsored project for developing a photo-voltaic energy system instrumentation using networked embedded microcontroller systems. $1,500 cash contribution.
1990-91: Private funding for developing the Robie Creek photo-voltaic powered home instrumentation and resource management.
1989-90: Idaho Power Company sponsored project developing an energy monitor for utility station batteries.

Honors and Awards:

University of Idaho Innovations Impacting Society Award, April 2011
University of Idaho Naval Officer Education Program Faculty Excellence Award, May 16, 2009
University of Idaho Alumni Award for Teaching Excellence. December 9, 2007
Best Session Paper, The 28th Annual Conference of the IEEE Industrial Electronics Society, IEEE IECON'02, Sevilla, Spain, November 5-8, 2002.
Best Session Paper, The 27th Annual Conference of the IEEE Industrial Electronics Society, Denver, Colorado, November 29, December 2, 2001.
Sabbatical Leave, July 1999-June 2000, Schweitzer Engineering Labs, write new text on computer based power system protection.

SERVICE:

Major Committee Assignments:

ECE ABET committee 2007 to present
ECE Lab Committee Chairman, September 2000-present
Computer Engineering Program Committee, January 1995-present
Graduate Faculty, Member, 1991-present

NIATT Director Search Committee, 2009
ECE Computer Engineer faculty search chairmen 2006-2007
University of Idaho Safety and Loss Control Committee, August 2004-2007, August 2010 to present
College of Engineering Safety Committee, August 2004-2007, August 2010 to present
ECE Faculty Search Committee, September 2000-March 2001
Computer Engineering Program Director, August 1997-May 1999
Electrical Engineering Search Committee, 1997-98 (2 CompE positions)
Electrical Engineering Lab Committee, 1990-97
Electrical Engineering Search Committee, 1993 (CompE position)
Electrical Engineering Search Committee, 1992 (3 Boise positions)
Electrical Engineering Search Committee, 1991 (EE position for Idaho Falls)
Electrical Engineering Power Laboratory, 1990-91

Professional and Scholarly Organizations:
Transportation Research Board, 2005-2008
IEEE, Senior Member, Power Engineering Society 1976 - present
Power Engineering Committee, 1999-2006
Towers, Poles and Conductors Committee, Bare Overhead Conductor Transient Rating Task Force 1986-96
Reviewer, 1993
IEEE Student Chapter Faculty Advisor, 1992-1995

Outreach Service:
Organizer of Advanced Accessible Pedestrian Signals Workshop, April 27,, 2009, Boise, ID
Organizer of Advanced Accessible Pedestrian Signals Workshop, April 25,, 2008, Moscow, ID
Organizer of Advanced Accessible Pedestrian Signals Workshop, January 21, 2008, Moscow, ID
Organizer of 2006 Smart Signals Workshop, Nov 2, 2006, University of Idaho, Moscow, ID
Chair for Vision and Imaging Systems Session II-02 at IEEE IECON'05, Raleigh, North Carolina, November 7-10
Paper reviewer for Transportation Research Board, 2005 -present
Paper reviewer for IEEE Intelligent Transportation Systems 2006
IEEE Industrial Electronics society reviewer, 2001-present
IEEE Spectrum reviewer, 1996-present
Book reviewer for J. Wiley on microcontroller and embedded computing, 2003
Submission Chair for IECON 03, Roanoke, Virginia, 2003
North Idaho Consortium Computer Engineering Program (Gonzaga, WSU, and UI) 2001-present
Organizer and Co-Chair for Special Session on Intelligent Transportation Systems Technologies at IEEE IECON'02, Sevilla, Spain, November 5-8
Workshop on embedded system design with structured high level computer languages, Advanced Input Devices, 1999
Organized IEEE Student Chapter at Boise Engineering Program, 1992

PROFESSIONAL DEVELOPMENT:

Research:

TRB Traffic Signals Systems annual meeting, Washington DC, 2005- present
TRB Traffic Signals Systems midyear meeting 2004-2007
ITE annual meeting 2007

Teaching:

Fundamentals of Transmission System Protection, Schweitzer Engineering Laboratories Protection course # 407, June 2002. $1,995 scholarship awarded.

Faculty Development Workshop on Learning and Teaching Styles, IEEE PES, Seattle, Washington, July 2000.

Faculty Development Workshop on Writing across the Curriculum, University of Idaho, Moscow, Idaho, January 1999.

Faculty Development Workshop on Verilog HDL, University of Colorado at Colorado Springs, June 1997.

Faculty Development Workshop on Process Education, University of Idaho, Moscow, Idaho, May 1996.

APPENDIX C: LETTERS OF SUPPORT

450 W. MCGREGOR
BOISE, ID 83705
WWW.PEDSAFETY.COM

April 19, 2011

Dr. Karen Den Braven, Director
National Institute for Advanced Transportation Technology
University of Idaho
PO Box 0901
Moscow, ID 83844-0901

Dear Dr. Den Braven,

I am writing this letter in support of the Idaho State Board of Education GAP grant for Dr. Wall's proposal of the commercialization of the Pedestrian Fault Monitor (PFM). Campbell Company is well established as a leader in the manufacturing of Accessible Pedestrian Systems (APS). Our company is a strong supporter of the Smart Signals technology research focus by Dr. Wall and his team of students and fellow faculty.

Our experience with talking with traffic agency engineers across the US and Canada that there is a strong interest in the type of device proposed for the PFM. This level of interest in the raising the level of secure operations for pedestrian signals is being propelled by new language in the 2009 edition of the US DOT Manual for Uniform Traffic Controller Devices concerning APS installations. The addition of PFM capability to the our existing line of pedestrian signal products will a great benefit to Campbell Company and the general public wherever pedestrian signals are used. We are committed to partnering with the University of Idaho to commercialize the PFM and integrate this device into the Advanced Accessible Pedestrian System that Campbell Company currently produces.

Best Regards,

Phil Tate

Phil Tate, President
Campbell Company
450 W. McGregor Dr.
Boise, ID 83705

U.S. Department of Transportation
Federal Highway Administration

Memorandum

Subject: An Accessible Pedestrian System Fault Monitor

Date: April 19, 2011

From: Paul. R. Olson, P.E., PTOE
ITS Technology Engineer
Lakewood, CO

To: Dr. Richard Wall
University of Idaho
Moscow, ID

The way traffic signals have handled pedestrian traffic was has largely been ignored for the past 50 plus years. The work of Dr. Wall on Smart Pedestrian signals has begun to change that. His current proposal is the next step in the development of technologies to provide better more intelligent service to pedestrians at traffic signals.

The development of appropriate fault monitoring of these systems is critical to a broader acceptance of more advanced pedestrian detection and service technologies.

On a broader scale the development of these systems, particularly those that would detect failed pedestrian detectors has the potential for beneficial impact to vehicle traffic. Currently there is no method available to detect and report a "stuck on" pedestrian detector. Many signals coordinated assuming few pedestrian calls. Each pedestrian call causes them to drop out of coordination to service the pedestrian call which can have a significant negative impact to vehicle traffic. A stuck pedestrian detector would make it impossible to provide coordination on the corridor until it is repaired. It is also important to note that changes in MUTCD to effective lengthen the pedestrian crossing time makes this impact even worse.

A stuck pedestrian push button can also have ancillary impacts to intersection safety as frustrated drivers being stopped and seeing no apparent reason to be so tend to run the red light.

I fully support and encourage the continuation of Dr. Wall's work in this area.

Sincerely,

Paul R. Olson, P.E., PTOE

MOVING THE AMERICAN ECONOMY