Technology Innovation Project

Project Brief

TIP 358: A Wearable Sensory System for Hazardous Source Locating and Exposure Level Warning

Context

Based on a report from National Institute for Occupational Safety and Health (NIOSH), from 1992 to 2010, a total of 2,432 construction workers died from electrocution at job sites. This was nearly half of the overall work-related electrocution deaths (5,104) in the United States*. Electrocutions were the fifth leading cause of death, accounting for 7% of all workplace fatalities. NIOSH investigated 224 electrocution incidents occurring during 1982 and 1994, The results indicated three major factors were related to injuries and deaths occurring when workers performed installation, maintenance, service, or repair work near hazardous energy sources**: 1) Failure to completely de-energize, isolate, block, and/or dissipate the hazardous energy source; 2) Failure to lockout and tag out energy control devices and isolation points after the hazardous energy source had been de-energized; 3) Failure to verify that the hazardous energy source was de-energized before beginning work.

Recent developments in portable electronics and mobile computing support the new area of Wearable Sensing and Computing Systems. Our system will be based on the incorporation of electromagnetic field (EMF) sensors and electric potential sensors into the wearable system that equips the electric industry worker with sensing capabilities beyond human perception. This project is expected to substantially enhance safety in the electricity related workplace.

Description

To respond to the challenge of electrocution prevention and workplace safety, we conduct research and development work to devise a wearable sensory system that aims to provide hazardous energy source detection and situational awareness for field workers.

The wearable sensory system contains a set of electromagnetic field (EMF) sensors and voltage potential sensors at the appropriate body positions for measuring EMF and ground potential, detecting and locating hazardous energy sources, and generating alerts of nearby highly energized energy sources. According to the results of EMF and ground potential measuring and signal processing, the situational awareness for safety and protection can be achieved in real-time. We expect such research and development efforts can introduce the state-of-the-art wearable sensing and computing technology into the field practice of power systems.

The specific tasks involved in this project include:

Task 1: *Development of a wearable sensory system for measuring electromagnetic field and ground voltage potential.*

Task 2: *Detection of highly energized and hazardous energy sources*

Task 3: *Detection of ground potential rise (GPR) using the wearable sensory system*

Task 4*: Localization of hazardous energy sources for real-time situation awareness*

Task 5: *Effective delivery of warnings to workers in the field. Develop graphical user interface, system integration and performance evaluation*

Why It Matters

Studies have shown that a good safety and health program can save $3 to $6 for every $1 invested, as occupational injury or death lead to major financial costs and legal consequences.

The primary benefit of this project is to provide maximum protection to BPA's field practice workers and contractors and thus to prevent life loss and severe danger from hazardous energy sources. The enhanced safety in working environments will enhance BPA's reputation in workplace safety.

Goals and Objectives

We expect this research and development effort will introduce a state-of- the-art wearable sensing and computing technology into the field practice of power systems, and substantially enhance safety in power system field practice.

Deliverables

The outcome of the project will be a wearable sensory system that is able to measure the electromagnetic field and ground potential surrounding a field practice worker, and it is able to detect, locate and warn the worker on the potential danger caused by highly energized power system components.

Deliverables will also include:

- The final technical report of the R&D project, including all the design, implementation, testing, results, and performance evaluation
- User manual for using theproposed sensory system and testing equipment, and how to use the hardware & software system in the work field

TIP 358: A Wearable Sensory System for Hazardous Source Locating and Exposure Level Warning

Project Start Date: October 1, 2015

Project End Date: September 30, 2017

Reports & References

* The Center for Construction Research and Training, "Fatalities from Contact with Electricity in Construction", in The Construction Chart Book - The U.S. Construction Industry and its Workers, 2013.

** National Institute for Occupational Safety and Health, "Worker Deaths by Electrocution: A Summary of NIOSH Surveillance and Investigative Findings", 1998

Links

Participating Organizations

University of Denver (DU)
National Renewable Energy Laboratory, (NREL)

Funding

Total Project Cost:	$4200,000
BPA Share:	$210,000
BPA FY2016 Budget:	$106,000

For More Information Contact:

BPA Project Manager:
Gordon Matthews, Technology Innovation
ghmatthews@bpa.gov

Principal Investigators
Jun Zhang, DU

Bradley Davidson, DU
David Wenzhong Gao, DU
Yingchen Zhang, NREL