

**American Electric Power Challenge: Health / Safety monitoring and alerts**

**Challenge:** Construct a device for worker health/safety monitoring and alerting. Ideas for the device include monitoring pulse and blood oxygen, motion, temperature/humidity, and UV detection. Students may use all of these sensor ideas or focus on a small group. The monitoring devices could be mounted on hard hats, safety vests, shirts, etc. Additionally, other ideas are welcome.

**Other Functions:** Functions such as text or email notifications could be added to alert the user or an operator to specific situations. The control module choices include Bluetooth options which could allow for phone apps to interface, log data or perform other functions.

A display, LEDs or buzzers could be added for local indications to the user. A small display and LCD screen is listed at the bottom. These are only two examples of many options. Individual LEDs would also work well.

**Materials:** The sensors are I2C and have unique addresses. If a 5V microcontroller is used, care needs to be used in interfacing with the 3.3V components. The Nano 33 is a 3.3V board so it is ideal to interface. The Nano 33 also has Bluetooth and an accelerometer built-in.

\*A RasPI 4 and Redboard has blue tooth included, but will need an external accelerometer. The PI 4 uses 3.3V for GPIO.

\*Many other options exist, but will likely need external accelerometers and blue tooth modules

Displays can be LCD-TFT Screens, individual LEDs, RGB-LEDs, etc. If a RasPi is used, the display can be on a computer monitor.

**Comments:** A limited amount of hard hats will be available for the students working on this challenge.

**Bonus Challenge** - Alerting when a worker enters an area that is 85 dB so you would know to put in your hearing protection or a sensor that detects any flammable gas and alarms at 10% of the lower explosive limit (LEL).

**Background:**



AEP’s Philosophy – “No aspect of operations is more important than the health and safety of people. Our customers’ needs are met in harmony with environmental protection.”

AEP is committed to social responsibility and sustainability. We are proactive in our efforts to protect people and the environment.

The AEP MakeOhio 2021 challenge is to construct a device for worker health/safety monitoring and alerting. The idea is that a device mounted on hard hats, safety vests, shirts, etc., that monitors workers' health and safety and provides an alert when something outside predetermined norms occurs.

This technology is essential because we have many jobs at AEP where workers must work for long periods by themselves. These jobs can be in a single location like power plants, or jobs out in the field where workers travel long distances alone.

In power plants, employees can work independently in hot, dark areas and go undiscovered for long periods if they were to experience a medical emergency.

Employees in the field perform work such as walking transmission right-of-ways and inspecting lines in remote areas.

AEP's line workers have to do their work which is often physical, in various environmental conditions. They can be working in Texas's searing dry heat, the humid and hot temperatures of Louisiana, or the cold winter temperatures of the Midwest. They could also be working far above

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the ground secured to a utility pole by climbing gear, or in a bucket on the end of a long lift device, or maybe in a utility subsurface vault with little air movement.

AEP personnel has to wear personal protective equipment such as heavy flame retardant clothing, hardhats, and sometimes wear heavy insulating rubber gloves and separately worn extensions of the gloves, called sleeves; the rubber insulating sleeves go up the arms and cover up to the shoulders. These line workers may be working in and around energized equipment, emitting electrical and magnetic fields.

All the way around, the work is mentally and physically challenging, and can lead to exhaustion in its many forms. Wanting to provide the ability to help these highly skilled and valuable members of AEP stay healthy and safe, we are looking to equip them with a wearable device that can monitor them and their environment in several ways.

### Microcontroller Options (There are many others)

- 1) Arduino Nano 33 BLE (\$23 at microcenter).



- a. Board works with standard Arduino IDE.
- b. Includes Bluetooth
- c. Includes Accelerometers, magnetic and gyroscope (9DOF)

- 2) RedBoard: Similar to Arduino, but with Bluetooth

<https://www.sparkfun.com/products/15444>

- 3) PI 4 has Bluetooth

<https://www.sparkfun.com/products/15447>

### Sensors:

- a) Pulse and Blood Oxygen (\$40)  
3.3V, I2C 0x55

<https://www.sparkfun.com/products/15219>



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- b) Accelerometer – 9DoF (\$17 **Do not need if you use the Nano 33**)  
3.3V, I2C 0x69

<https://www.sparkfun.com/products/15335>



Note: many choices for this. Only one example

- c) Environmental: Temp/Humidity/Press (\$15)  
3.3V, I2C 0x77

<https://www.sparkfun.com/products/15440>



Note: Many choices for this. Only one example.

- d) UV/IR/Visible (\$10)  
3.3V, I2C: 0x60

<https://www.adafruit.com/product/1777>



**Displays:**

- a) Micro OLED \$16  
3.3V, SPI or I2C

<https://www.sparkfun.com/products/13003>



- b) LCD: 16x2 \$20  
3.3V, SPI or I2C

<https://www.sparkfun.com/products/16396>



Note: Many choices for displays. Individual LEDs are also an option.