LA Delta and LA Tech: New Instrumentation Curriculum

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LATM/LSTA Joint Conference

10/23/18

This material is based upon work supported by the National Science Foundation under Grant No. 1801177.

- Why?
- Demo
- Program Components
- Benefits to Teachers/Counselors
- Timeline
- Feedback

Why?

- Louisiana industry needs

THE HAYES COcompanies, PINEVILLE

ADVANCED MANUFACTURING

CHENNAULT INTERNATIONAL AIRPORT, LAKE CHARLES

AEROSPACE

TABASCO, AVERY ISLAND

AGRIBUSINESS

FERRARA FIRE APPARATUS, HOLDEN

AUTOMOTIVE

OCEANEERING INTERNATIONAL INC., MORGAN CITY

ENERGY

PRESONUS, BATON ROUGE

ENTERTAINMENT

METHANEX, GEISMAR

PROCESS INDUSTRIES

IBM, BATON ROUGE

SOFTWARE DEVELOPMENT

GOOSE POINT

WATER MANAGEMENT

More than 1,600 students to join North Louisiana Manufacturing Week

Oct 1, 2018

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Why?

- Louisiana industry needs
- “Instrumentation and controls” is a high-tech, good-paying career
  - Not known/communicated
  - 2-yr or 4-yr degree pathways
- Partners especially suited

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- Louisiana science standards, focus on STEM and applications of science/math
- Job skill initiatives – JumpStart pathways

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Let's Make a Sous Vide!

- Cooking device that maintains an elevated temperature in a vessel
- Gives us practice:
  - Devising and reading a temperature sensor using a microcontroller
  - Controlling a high-current device (heating element) using the microcontroller

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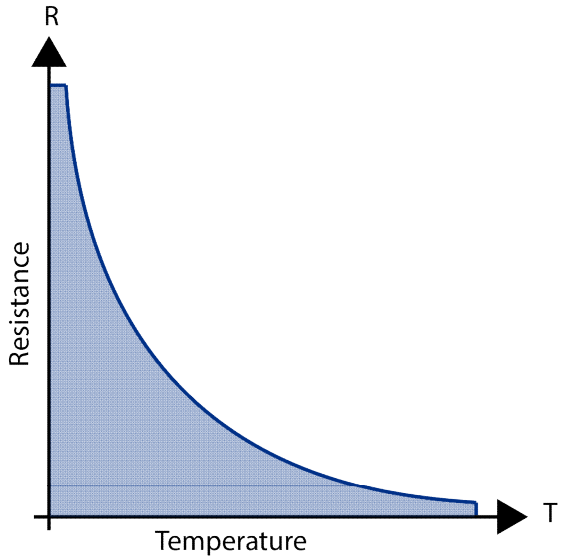
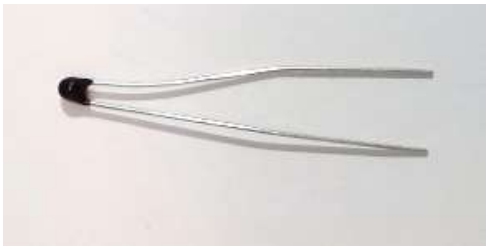
What is a Thermistor?

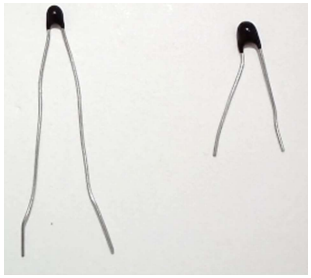
- Measures electrical resistance changes with temperature
  - Resistance decreases as temperature increases



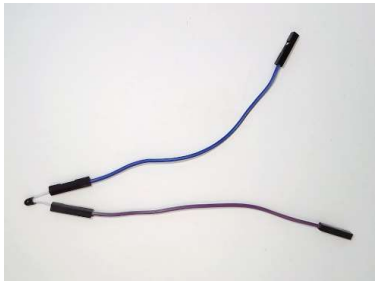
Circuit Diagram Symbol:



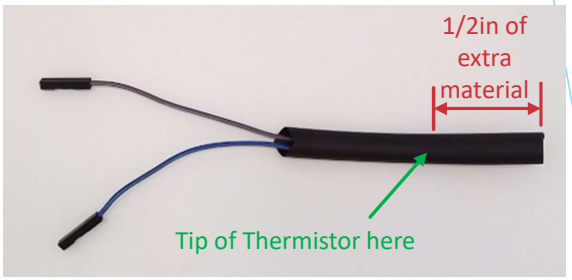
Waterproofing Thermistor



Clip approx. 1/2in off of thermistor legs

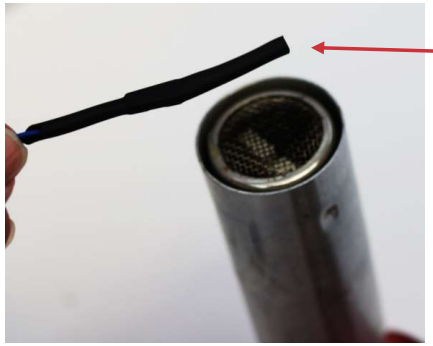


Attach wire extensions to each leg



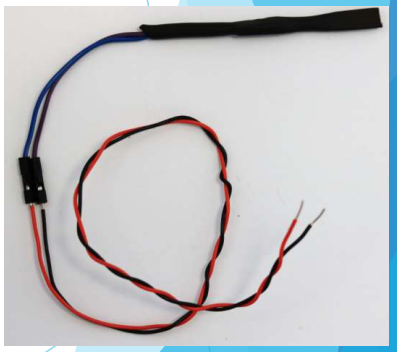
Cut heat shrink material to approx. 3in and slide it over the thermistor

Note: Leave approx. 1/2in of material passed the thermistor to be used as for a seal



Shrink material using heat gun

Clamp end of heated material to seal in the thermistor
Be sure to not crush the thermistor when clamping material



Strip wires jumper wires and connect them to wire extensions

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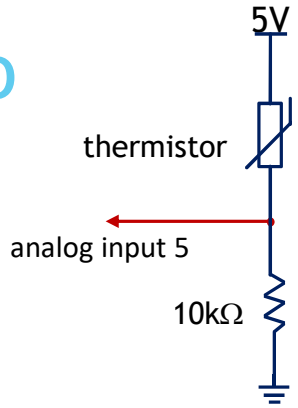
Interpreting Signal Using Arduino

- analogRead values can be converted to voltage drop across the 10kΩ resistor

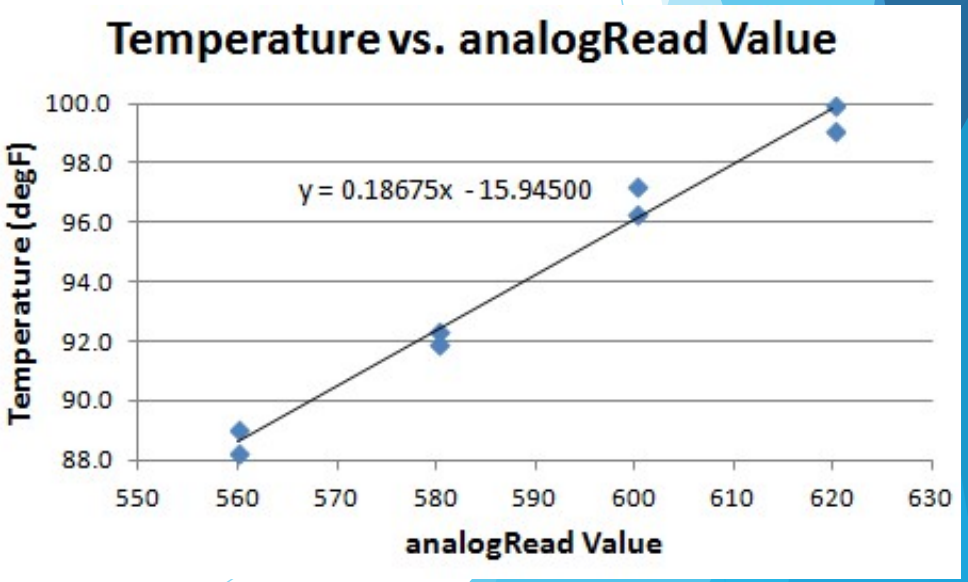
$$voltage = \texttt{analogRead}\ value \cdot \frac{5\ volts}{1023}$$



- Alternatively, analogRead values can be calibrated to temperatures using a curve fit

```
temp = 0.18675*sensorValue - 15.945
```

	analogRead Value	Temperature (degF)
rising temp	560	89.0
	580	91.9
	600	97.2
	620	99.9
falling temp	620	99.1
	600	96.3
	580	92.3
	560	88.2



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What are relays?

- Relays are switches that are turned on and off using electricity
- Relays allow a low-power signal to control a large amount of power
- Relays are all around us

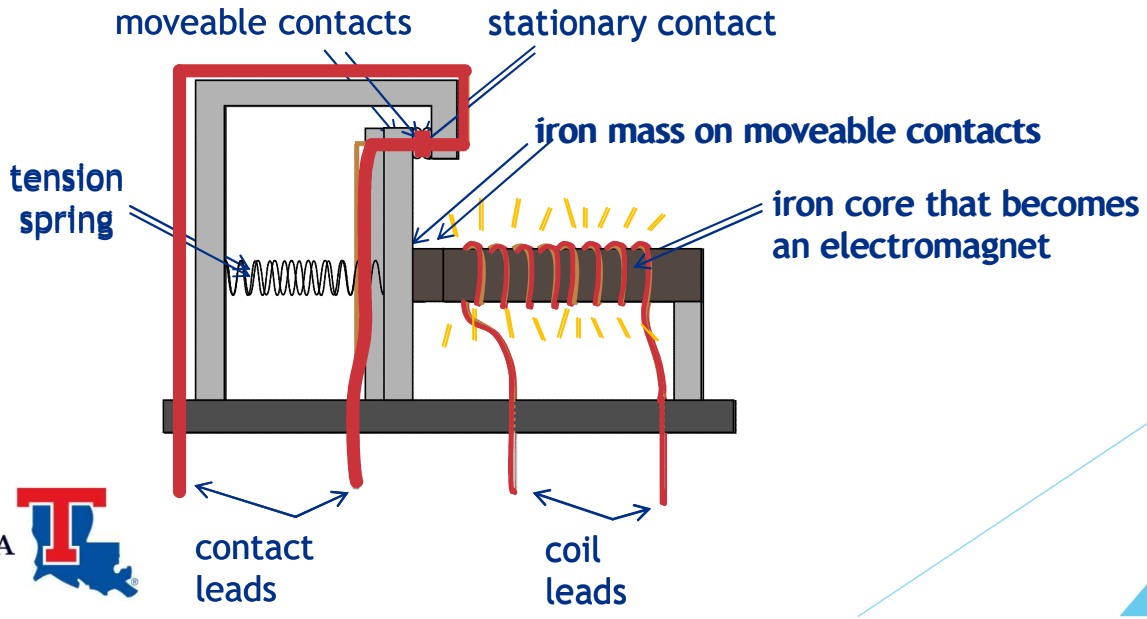
Automobiles

Refrigerator - turns on compressor when temp gets low

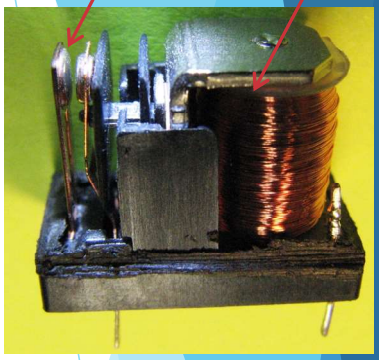
Industrial Controls

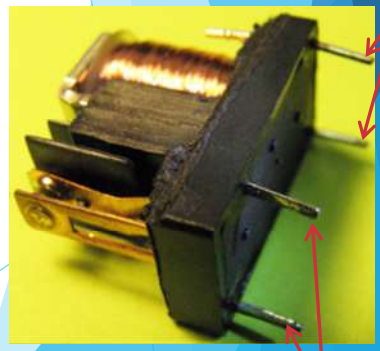
How do relays work?

- Relays pass a small current through a coil which causes the iron core to become magnetized
- This electromagnet attracts an iron mass on the moveable contact causing it make contact with the stationary contact
- With the contacts touching, a much larger current can pass to drive the load of the circuit



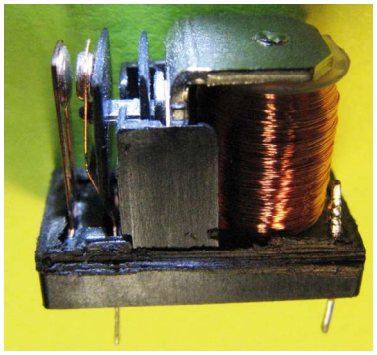
Inside the relay used here

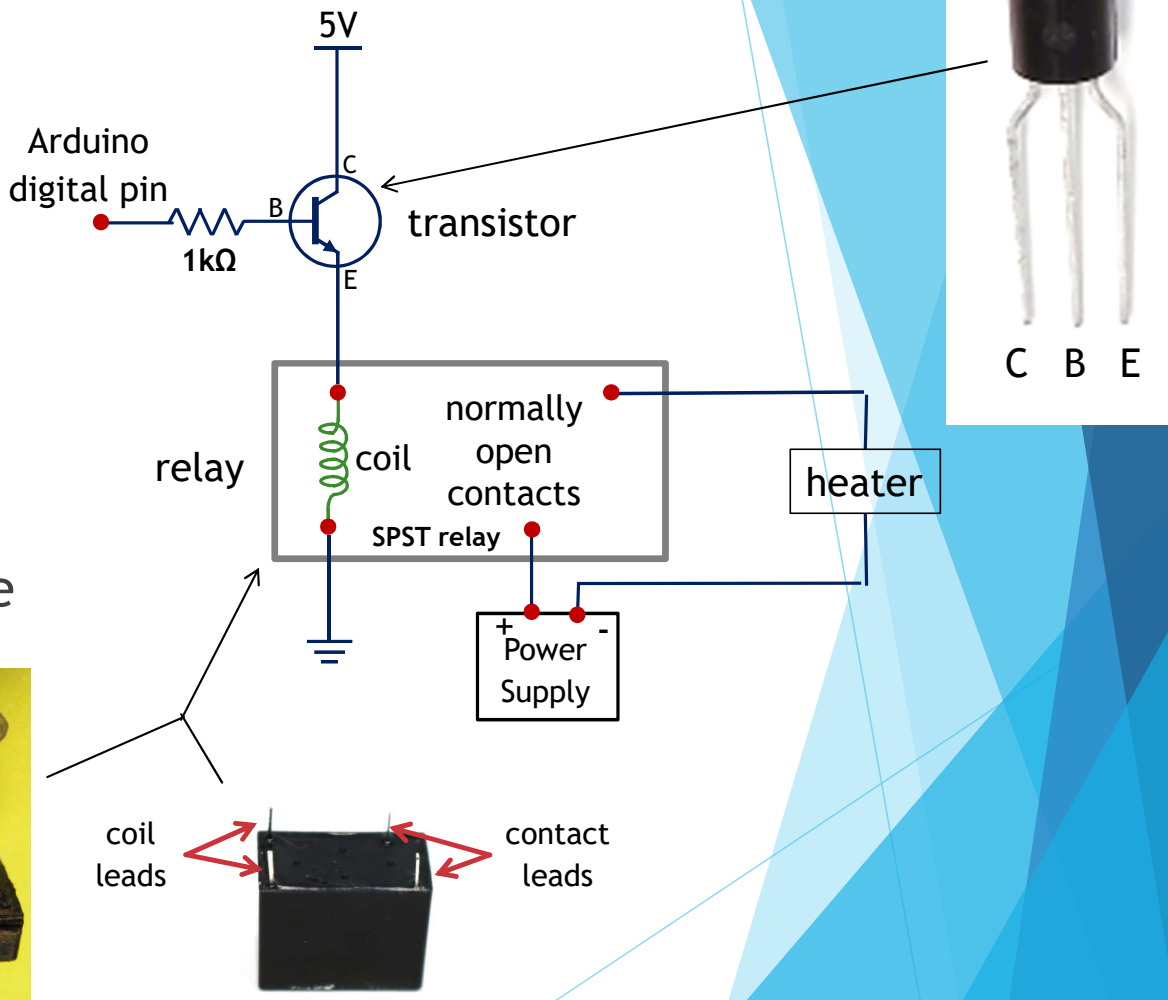




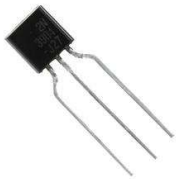
Wiring

- Setting the digital output on the Arduino to HIGH switches **on** the transistor
- The transistor allows current to flow through the relay coil, closing the relay contacts
- Power from power supply energizes the heater, heating the water





Power Considerations



1. Power to switch transistor
   - source: Arduino digital I/O pin
   - max current per digital I/O pin: 20 mA

2. Power to switch relay
   - source: 5V from Arduino (from the on-board voltage regulator)
   - max current from the voltage regulator: 800 mA
   - coil current for relay: 40 mA

3. Power to heater
   - source: 12V power supply
   - max current: Up to 2A

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Arduino Program

- Senses the voltage input on analog pin 0 and stores as a number between 0 and 1023
- Computes decimal voltage value and temperature value
- Sends values back to the computer to show in the “serial monitor”
- Decides if heater needs to be turned on or off
- Sends heater state to serial monitor
- Waits 5 seconds and repeats

```
void loop() {

  sensorValue = analogRead(A0);

  voltage = sensorValue * (5.0 / 1023.0);
  temp = 0.18675*sensorValue - 15.945;

  Serial.print(sensorValue);
  Serial.print("  ");
  Serial.print(voltage);
  Serial.print("  ");
  Serial.print(temp);
  Serial.print("  ");

  if (sensorValue<589) {
    digitalWrite(9, HIGH);
    heaterState = 1;
    }
  else if (sensorValue>599) {
    digitalWrite(9, LOW);
    heaterState = 0;
    }

  Serial.print(heaterState);
  Serial.print("  ");

  if (heaterState == 1) {Serial.println("ON");}
  else                  {Serial.println("OFF");}

  delay(5000);
}
```


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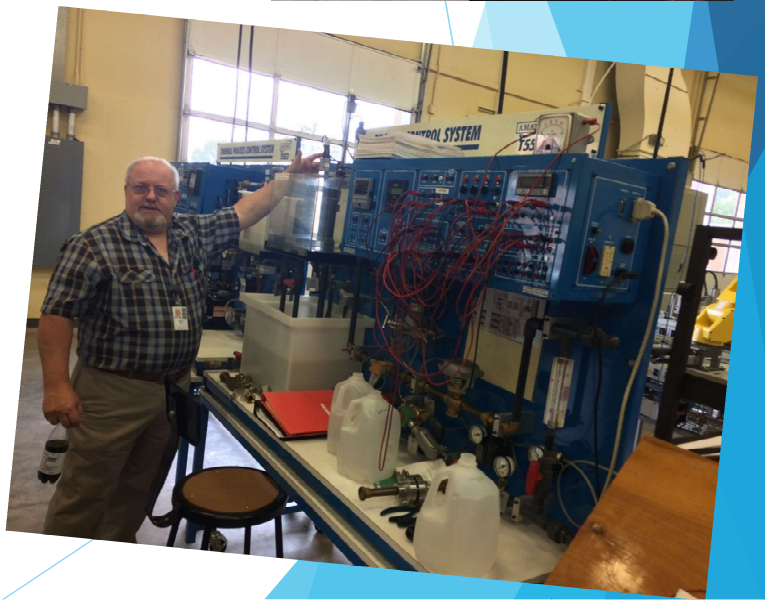
Program Components

- Controlling, Operating, and Measuring: Pathways for Learners to Engineering Technology Employment (Project COMPLETE)
- Hands-on, project-based “instrumentation and controls” curriculum for one course
- Dual enrollment and articulation agreements
- Scholarship program
- Lunch-and-learns



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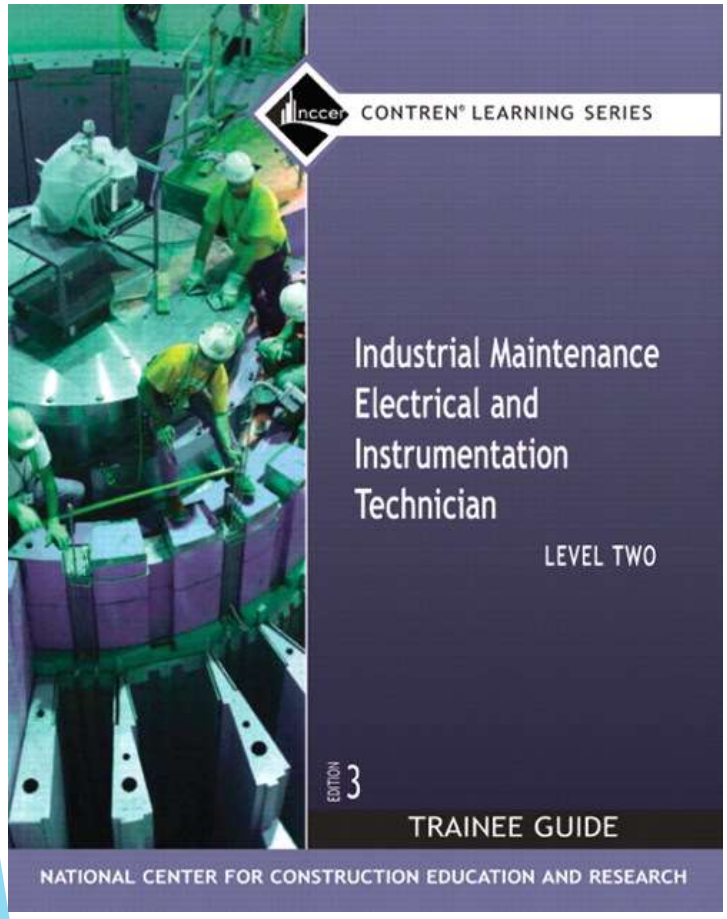

Sampling of NCCER Level 2 Curriculum Topics

- **40203-08 Electrical Theory** (15 Hours)
- **40204-08 Alternating Current** (20 Hours)
- **40205-08 E & I Test Equipment** (10 Hours)
- **40206-08 Flow, Pressure, Level, and Temperature** (15 Hours)
- **40207-08 Process Mathematics** (15 Hours)
- **40211-08 Instrument Drawings and Documents, Part 1** (15 Hours)

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Benefits to Teachers/Counselors

- New career path for students
- Easily-implementable, hands-on projects for your classroom
- Project kits
- Workshops and continued communication to support and guide
- Support for counselors in understanding and communicating career paths
- Stipends for participation

Notes for Administrators:

- Explore state funding
- Consider pairing with core course

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Timeline

- Year 1 (2018-2019)
  - Develop curriculum, explore JumpStart pathway, gather feedback
  - Summer 2019 workshop
- Year 2 (2019-2020)
  - Implement curriculum, gather feedback
  - Scholarships and lunch-and-learns
  - Workshops
- Year 3 (2020-2021)
  - Continue and expand program

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Q & A

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