MATE's Diving into Sensors – Course Outline

1. Getting all the Pieces Together

In this Module, you will gather all the pieces required for this course

You will need the following items:
1. Sensor Kit - includes Arduino board and USB cable.
2. Textbook - *Make: Sensors* ISBN: 978-1-449-36810-4.
3. Soldering Iron & rosin core solder and wire cutters.

<u>Learning Outcomes for this Module:</u>
- ✓ Conduct the necessary operations to build a hardware and software development environment for sensor interface and programming.

2. Who's in Control Here?

Introduction to Arduino & Processing
1. What is a Processor?
2. How do I get the processor to do what we need?
3. How do I communicate with the processor?
4. Trying it out for the first time.

<u>Learning Outcomes for this Module</u>
- ✓ Able to identify the basic components of a microprocessor.
- ✓ Describe the basic elements of a programming language.
- ✓ Describe computer input and output pathways.
- ✓ Develop a simple computer program.

3. Controlling the World (Digital)

Understanding the fundamentals of computer Input and Output
1. What is a switch? How can it be used to signal the processor?
2. What is a digital input and output?
3. Simple inputs: switches and pushbuttons.
4. Simple outputs: LEDs and relays.
5. Programming the processor to bring them all together.

<u>Learning Outcomes for this Module</u>
- ✓ Design a software program to read a processor input and control a processor output.
- ✓ Describe the difference between a processor input and output.

4. The World is More than Black and White (Analog)

Computers and Analog Signals
1. What is meant by analog and how does it differ from digital?
2. What Sensors provide analog information?
3. Simple inputs: reading a potentiometer.
4. Simple inputs: programming to create a simple voltmeter.

5. We Need the Human Touch

Expanding on the Types of Analog Input Devices
1. What is a joystick and how does it differ from a potentiometer?
2. Simple inputs: reading a joystick.
3. Simple inputs: programming to create two axis of control.

Learning Outcomes for this Module
- ✓ Explain why one would use a Joystick instead of two potentiometers.
- ✓ Create programming necessary to control a two axis device.

6. System Monitoring is Always Good

System Monitoring
1. What is a Voltage Divider?
2. Using Voltage Divider to Monitor System Voltages.
3. Analog Input Protection.
4. Simple inputs; Programming to read a signal from a voltage divider.
5. Simple outputs; Programming to display a monitored signal scaled to voltage units.

Learning Outcomes for this Module
- ✓ Design a voltage divider circuit to properly scale a sensor signal.

7. How Hot is it Down There?

Using Temperature Sensors to Monitor the Environment
1. Using a Voltage Divider to Measure Temperature.
2. Types of Analog Temperature Sensors.
3. Types of Digital Temperature Sensors.
4. Simple inputs; Programming to read a RTD Temperature Sensor.
5. Simple inputs; Programming to read an analog sensor with digital alarm

Learning Outcomes for this Module
- ✓ Explain how a voltage divider is used for analog temperature sensors.
- ✓ Create programming to display external temperature.

8. Is there Light Down There?

Using a Photo-resistor Sensors to Monitor Deep Sea Light Levels
1. What is a Photo-resistor?
2. Simple inputs: Programming to read Photo-resistor Light Sensor.
3. Simple outputs: Programming to turn an illumination LED on.
4. Simple System: Putting the two together to measure light transmissivity in a water column.

Learning Outcomes for this Module
- ✓ Design a monitoring system for performing action based measurements.

9. Is it Metal or Plastic?

Using Hall Effect Sensors to Detect Metal
1. What is a Hall Effect?
2. Analog or Digital Sensor?
3. What is the effective distance it can detect metal objects?
4. Simple Inputs: Reading a Hall Effect Sensor and determining detection distance.

Learning Outcomes for this Module
- ✓ Construct a measurement and display system capable of identifying metal objects

10. Is your ROV Leaking?

Water Detection inside Electronics Housings
1. What types of sensors are available?
2. Should we use an analog or digital sensor?
3. Constructing a simple analog water sensor.
4. Simple Inputs: Programming a water detection system.
5. Simple Outputs: Programming a beeping alarm for water leaks.

Learning Outcomes for this Module
- ✓ Determine the proper sensor for water detection
- ✓ Design and implement a water detection and alarm system

11. Housekeeping and other Bits

Putting Sensors Underwater
1. What are some simple waterproofing methods?
2. Can we put this in an enclosure?
3. Problems with running long sensor leads to the surface.
4. Electromagnetic effects on your sensors. (How your motors can mess everything up.)
5. Your Measurements will be only as good as the electronics environment. (Power Supply Filtering)
6. Investigation: Observe and measure the effects of Electromagnetic Interference (EMI) on sensor data.

Learning Outcomes for this Module
- ✓ Determine the method for sensor waterproofing.
- ✓ Recognize the effects of EMI on sensors.

12. Advanced Topic: Who's Making All That Noise?

Underwater Hydrophone
1. Connecting to the microphone modules.
2. Methods of waterproofing the microphone.
3. Sampling continuous data streams

Learning Outcomes for this Module
- ✓ Recognize the importance of sampling rate on sensor data.