EMU Construction Video Script

The following is the script for our EMU construction video below:
https://youtu.be/74yjZC-QKPY

Video Visuals	Audio & Captions
Title: EMU Construction Video "Part I: Parts Overview" -Components of EMU are shown and described	Right now we are going to show you the main components of these ecological sensor units.
	First, we have the breadboard which we will cover in detail later on.
	Next we have WeMos D1 mini, with the wifi chip on the top here and usb connector in the front of the unit.
	Next we have the P-channel MOSFET switch.
	And this is the DS3231 clock which as you can see requires its own watch battery for our set up.
	Here we have the ADS1115 16 bit Analog to Digital Converter which is used in conjunction with the soil moisture probe.
	Moving on to the sensors:
	We have the BME 280 temperature, humidity and air pressure sensor.
	This is the BH1750 light sensor, and this is the soil moisture sensor.
	The batteries for the unit are housed in this battery case. Here we have a case that can hold 3 standard AA batteries.
	*Note: We switched to 4xAA batteries for better performance.
	For a full parts list please take a look at the links below.

"Part II: Soldering the Sensors" -Resistors are removed off of clock and BH1750	Of course, not everything comes ready to assemble, so in this part we will have to alter some of the sensors. If you never soldered before don't worry! I'd advise practicing a few times before this next step. Using your solder, we want to carefully remove 2 resistors from the clock. The first one we are removing is the resistor next to SDA and VCC on the right side of the sensor that has a small label saying "472". To remove, heat up your soldering tool and delicately push from the side of the resistor until it comes loose. Use the same process now with the second resistor that says "102" in the top left corner of the sensor. *Note: Removing the 472 resistor from the clock removes the pullup on the SQW pin. This is required to use the clock to turn on the MOSFET in our setup. Additionally, removing this resistor gets rid of the pullups on the SCL and SDA I^{2}C data lines. When other I^{2}C sensors are included (as in our setup) these are redundant. *Note: Removing the 102 resistor disables charging of the internal battery. This does not work well anyway at 3.3v, and we prefer the non-rechargeable CR2032 battery, which can be damaged by charging. Next you are going to remove the two 472 resistors from the top of the top of the BH1750 light sensor. *Note: As with the clock above, these resistors are for the I^{2}C data lines and are redundant if more than one I^{2}C sensor is used.

"Part III: Wiring the Breadboard"
 	
-Step by step instructions of wiring the breadboard are described
	If you have never dealt with a breadboard it's okay! Think of a breadboard as an electrical circuit. The + and – are "power rails" which is where you can easily get power from in your breadboard. The "horizontal rows" in the middle area are also separately connected from columns A through E and then columns F through I, and then again we have "power rails" columns + and - again on the other side. It is important to remember that the 2 power rails are separate, they are not connected.
	
	To start, let's begin on the uppermost corner of the breadboard. You want to cut a wire that will connect from (-) to A2.
	
	As a side note, it doesn't matter where in the (-) or (+) the wires are being placed into, the spots in each row have the same positive or negative charge.
	
	Next, cut a similar length wire to attach (-) to A11.
	
	Moving down the breadboard, next up is connecting (+) to A13.
	
	Link column (–) to A22 and then (-) to A29.
	
	Moving over into column B, cut a wire a bit longer to join the following wires from:
	  B21 to B28
	  B19 to F23
	  B20 to F24
	
	Now move along to column C. You are going to take a wire, even longer than

the last wire you cut, and connect C2 to C11.

Moving over to column D, join D1 to D10.

*Note: the D1-D10 wire is actually redundant with C2-C11. The ESP8266 is very sensitive to grounding, and we find that two wires sometimes improves reliability

Column E is where the wiring gets a bit tricky. Using a long piece of wire attach it from E5 to J23 and then another from E6 to J24.

Then use a small piece of wire for E10 to E14 and E15 to E18.

Continuing down the breadboard, you are going to cut 2 small pieces of wires for the following:
  E21 to F21
  E22 to F22
And use a slightly longer wire for E30 to F27.

Now on the other side of the breadboard, use 3 small pieces of wire to attach:
  J1 to (+)
  J21 to (+)
  F8 to H6

Hang in there guys! Only a couple more steps until Part 4.

Next add the resistors. 2 types of resistors are needed: 330k and 100k. The 100k resistor connects 13 to 15 in column D and the 330k joins column C1 to H7 and another in J5 to (+). Be careful to make sure the wires from the

	resistors are not touching the exposed segments of the connectors.

* Note: The resistor from D13-D15 is a "pullup resistor" that pulls the MOSFET gate weakly to (+) to make sure it is "off". When we give it (-) from the clock, it turns on the switch.

*Note: The 330k resistor allows the D1 Mini to measure battery voltage up to 6.5v. Without it, the D1 Mini can only measure voltage up to 3.3v

*Note: J5 to (+) is actually 100K resistor, another pullup used to disable code from running.

Lastly, grab the p-channel MOSFET 3 pin and place them in the left side of the breadboard from C13 to C15.

* Note: The MOSFET must be oriented in same direction as in the video. |
| "Part IV: Final Assembly"

-All components are attached and unit is shown in environment. | Next up on our list is to install the Wemos, ADS1115, DS3231 clock, BH1750 sensors, and the wires for the BME280, BH1750, and soil moisture probes which will be the only sensors located on the outside of the container. In order to install the wemos sensor, you are going to line up the 5V pin on the Wemos into B1 and the 3V3 pin into I1.

Next, take the ADS1115 and attach the ground pin to I21 to I30. The DS3231 clock is placed from D17 to D22.

The wires for the BH1750 light sensor attaches to G21 to G24.

*Note: Make sure the order of the sensor pins matches ADS1115 on breadboard |

The wires for the BME280 attaches to H21 to H24. Lastly, the wires for the soil moisture probe attach to D28 to D30.

Finally, the battery pack can be connected to the breadboard by placing the plus and minus wires the corresponding positive and negative columns on the top of the breadboard.

*Note: Make sure to attach battery to +/- strip next to column A, rather than column J.

Now that we have everything wired to the breadboard, we can seal the container. Now we are ready to see it in action

The EMU unit is not only capable of being made at home, but it is also accurate and cost effective compared to other sensors currently on the market. To learn more about the setup, parts, or see our comparative data results please look at the attached links in the description below.
https://github.com/mickley/EMU