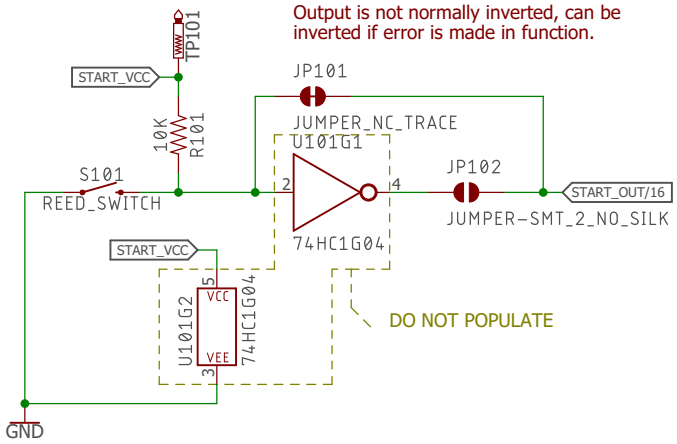

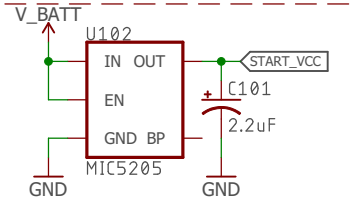

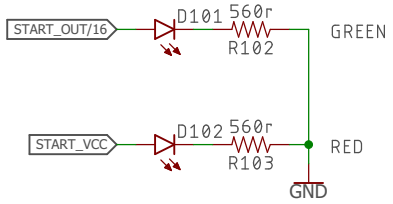

A reed switch is released by a magnet. The switch outputs a signal to begin the next transfer.

"Participants must detach and remove a magnet from the device; this action of detaching the magnet must begin the chain of events due to the removal of the magnetic force."

STARTING ACTION

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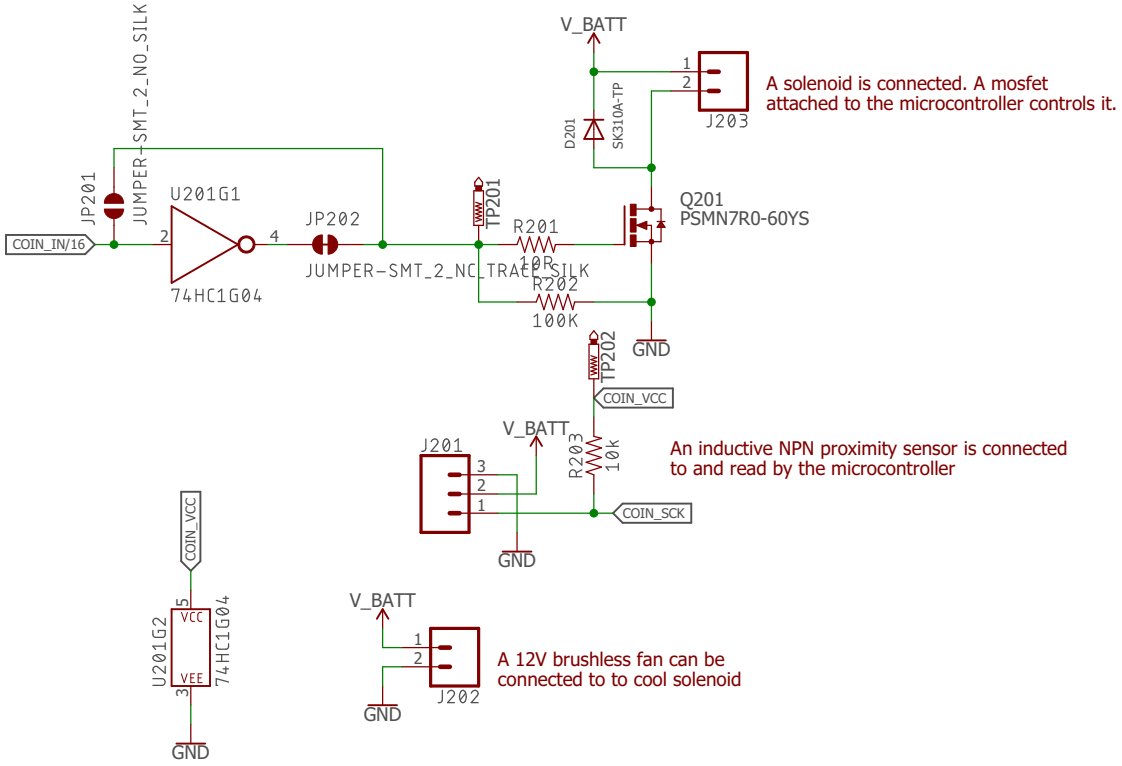
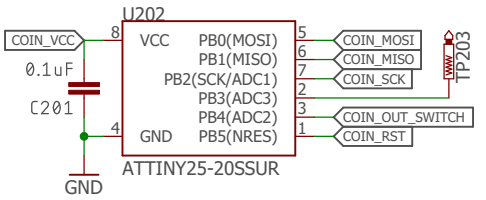
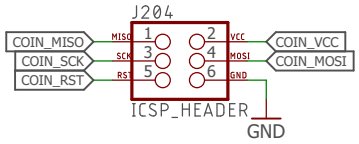
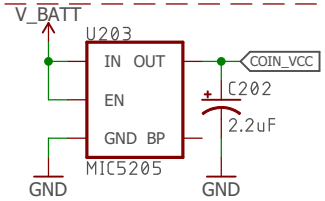


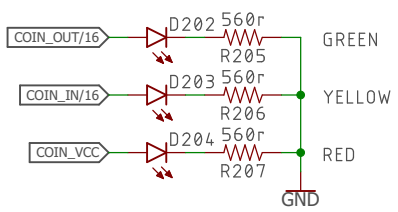
A solenoid starts out on, with a penny sitting above its plunger, hanging off a ledge. The solenoid releases at the beginning of the transfer, flipping the penny airborne. The penny triggers an inductive proximity sensor which is connected to a microcontroller that triggers the next action.

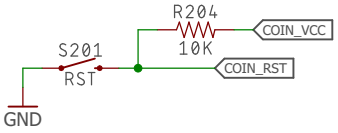
"Flip an unmodified US quarter airborne so that it goes from heads up to tails up and begins the next action."

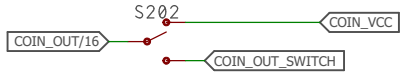












COIN FLIP ACTION

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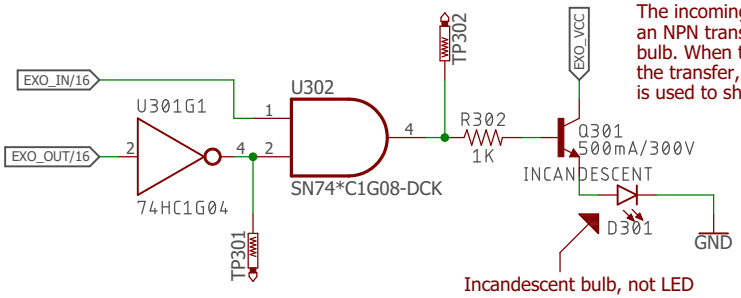
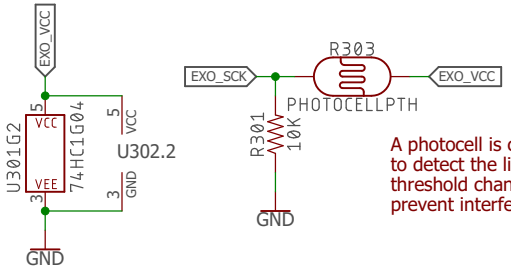


The incoming ON signal is fed into the base of an NPN transistor which feeds the halogen bulb. When the incandescent bulb has completed the transfer, the microcontroller's output signal is used to shut the bulb element off.

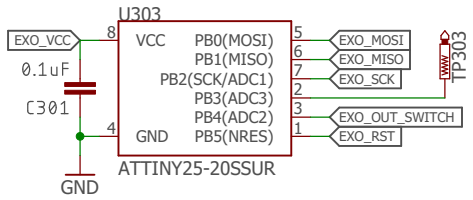
Incandescent bulb, not LED

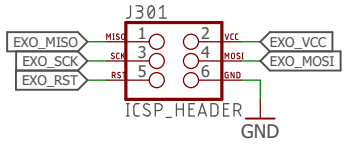


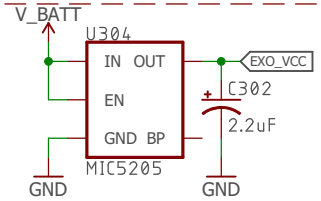
A photocell is connected to the microcontroller to detect the light coming from the bulb. A threshold change must be met in order to prevent interference from ambient light.

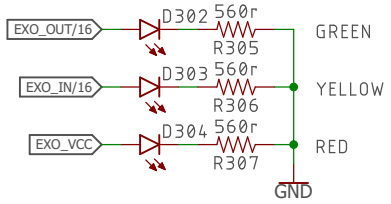
An incandescent bulb is turned on by the previous transfer and turned off by the output of the transfer. The microcontroller turns on the output when the photocell resistance drops a certain amount.

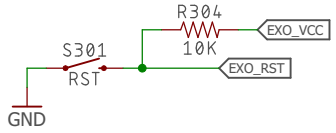
"Use an exothermic action that produces light to activate a photocell and begins the next action."











EXOTHERMIC ACTION

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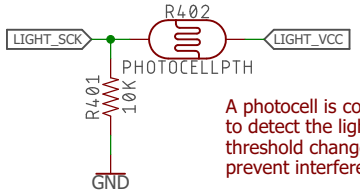
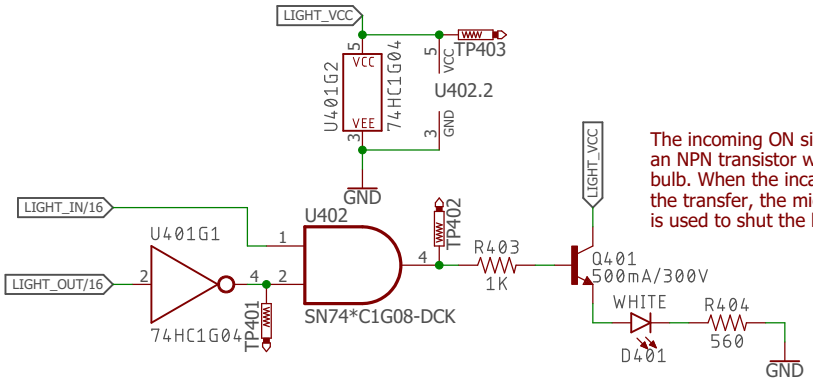


A photocell is connected to the microcontroller to detect the light coming from the bulb. A threshold change must be met in order to prevent interference from ambient light.

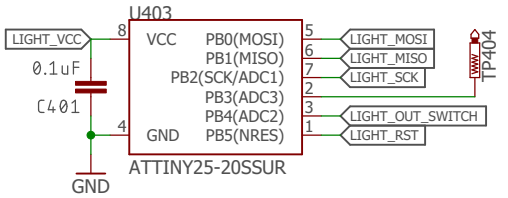


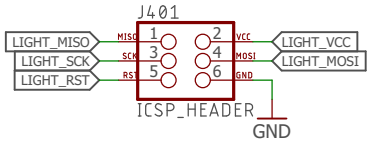
The incoming ON signal is fed into the base of an NPN transistor which feeds the halogen bulb. When the incandescent bulb has completed the transfer, the microcontroller's output signal is used to shut the bulb element off.

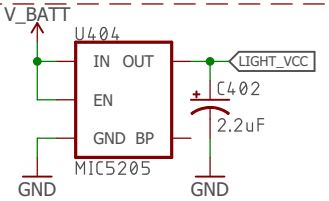
An LED is turned on by the previous action. The LED makes the phototransistor change its resistance, signaling the microcontroller to proceed to the next action. The output signal turns the LED off again.

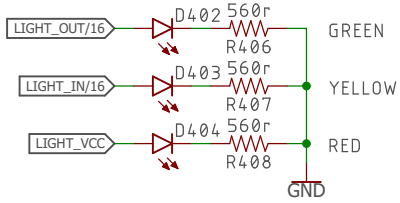
"Use light to initiate a chemical reaction to begin the next action."

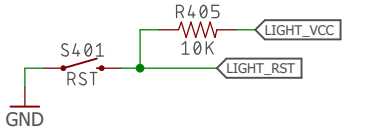
CLARIFICATION:
"Use light to initiate the next action."

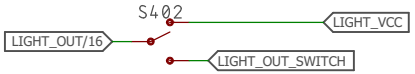












LIGHT TRIGGERED ACTION

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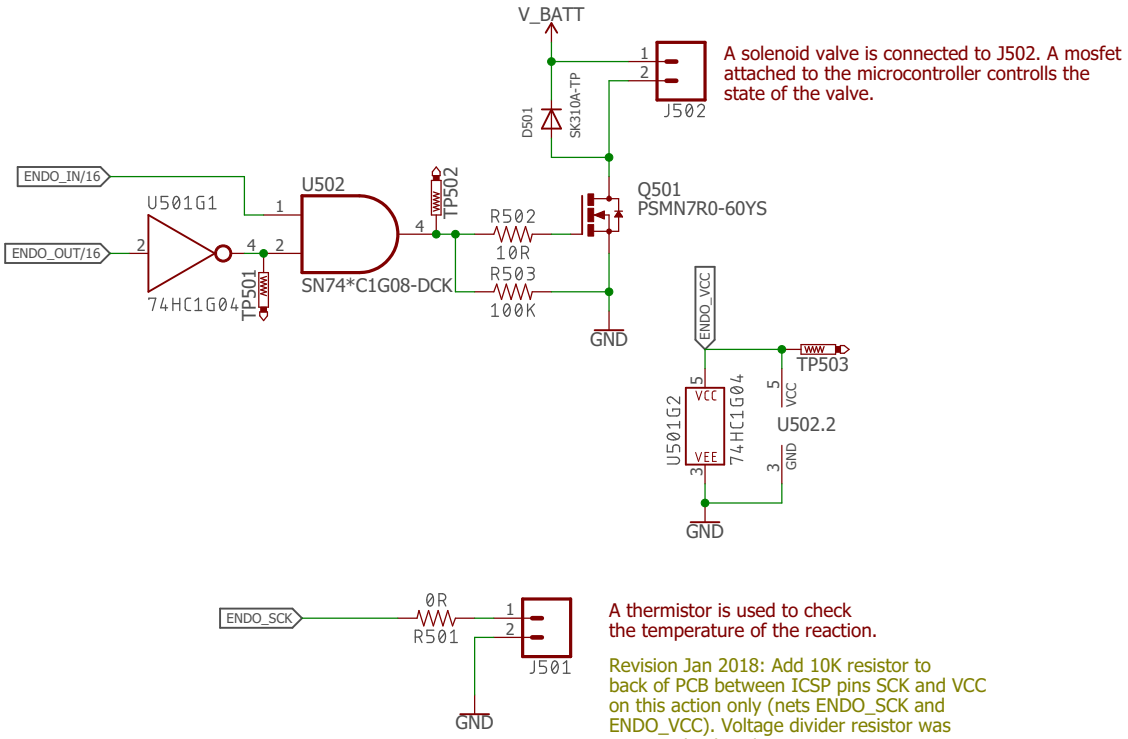

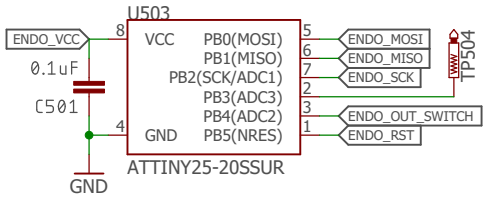

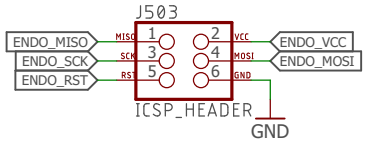

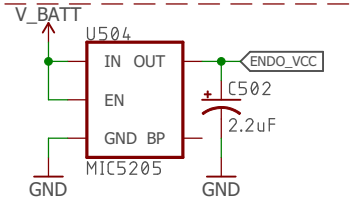

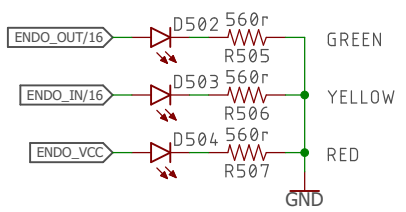

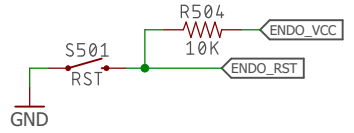

A solenoid valve is opened, releasing water into a test tube containing ammonium nitrate powder. The powder dissolves in an endothermic reaction, causing the resistance of a thermistor to change.

"Use an endothermic action that begins the next action as a result of the reduction in temperature."

ENDOTHERMIC ACTION

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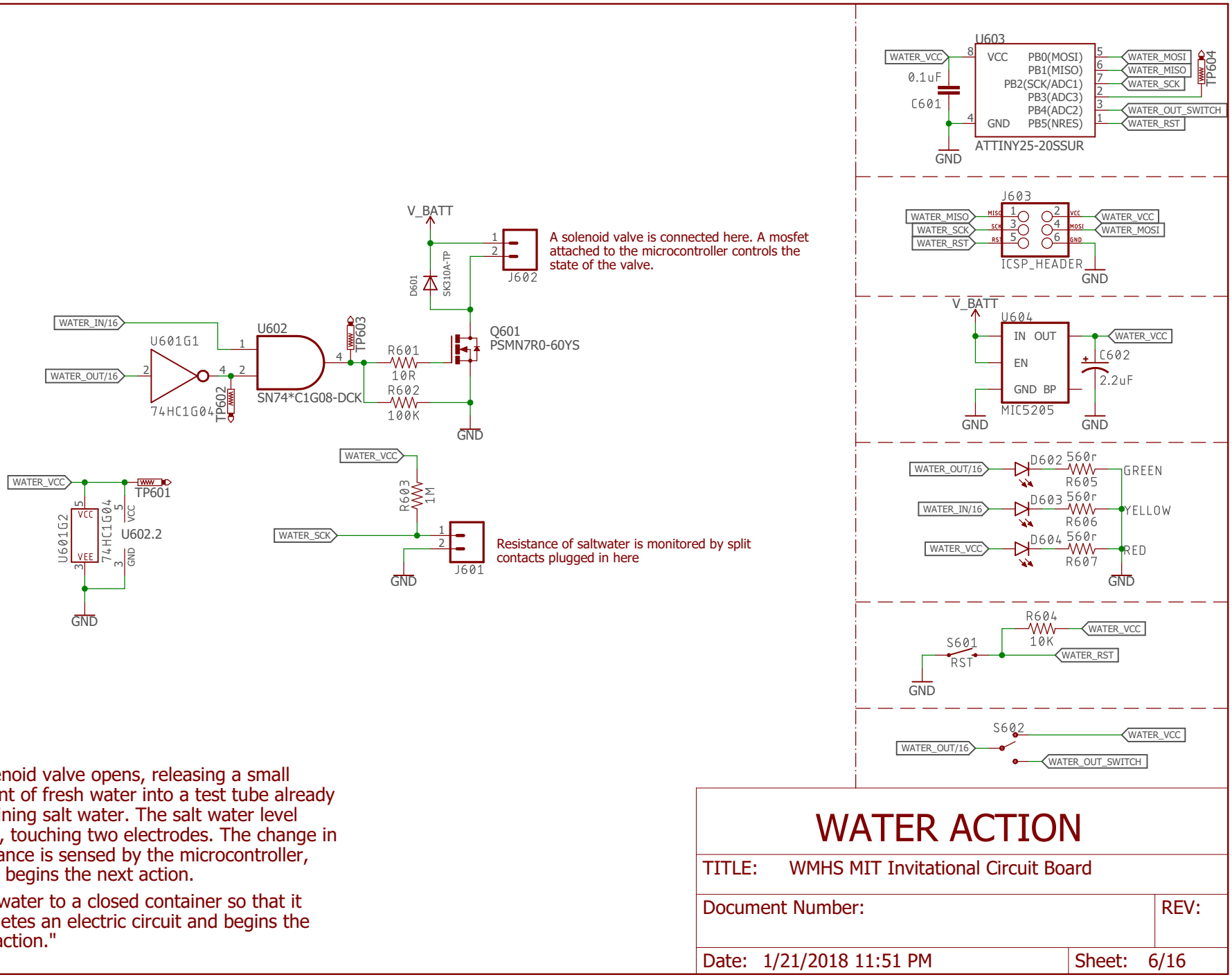

A solenoid valve opens, releasing a small amount of fresh water into a test tube already containing salt water. The salt water level raises, touching two electrodes. The change in resistance is sensed by the microcontroller, which begins the next action.

"Add water to a closed container so that it completes an electric circuit and begins the next action."

WATER ACTION

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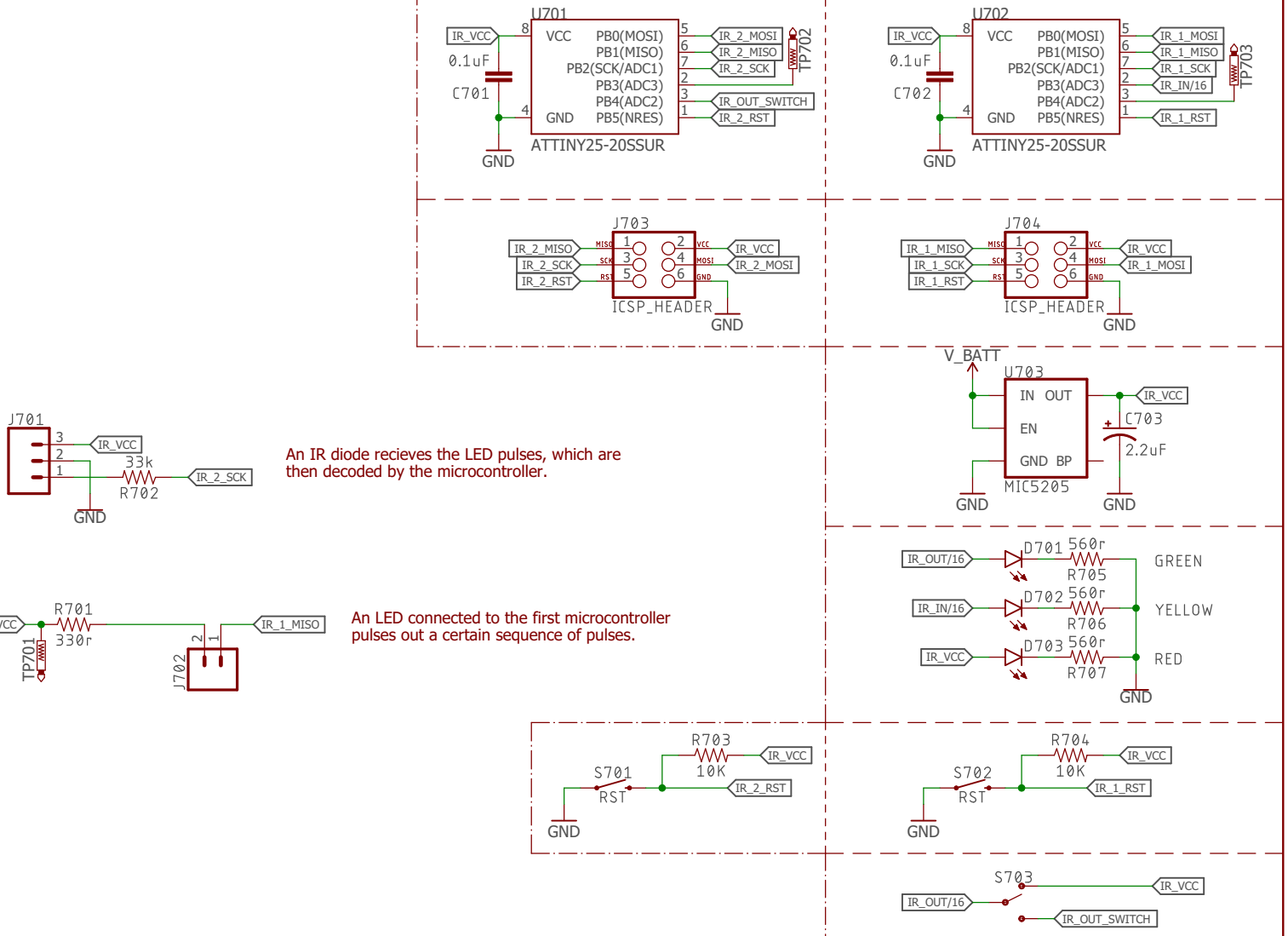

An IR diode recieves the LED pulses, which are then decoded by the microcontroller.

An LED connected to the first microcontroller pulses out a certain sequence of pulses.

An LED is turned on by the previous action. The LED makes the phototransistor change its resistance, signaling the microcontroller to proceed to the next action. The output signal turns the LED off again.

"Use an infrared beam where the transmitter and receiver are at least 20 cm apart to begin the next action."

IR ACTION

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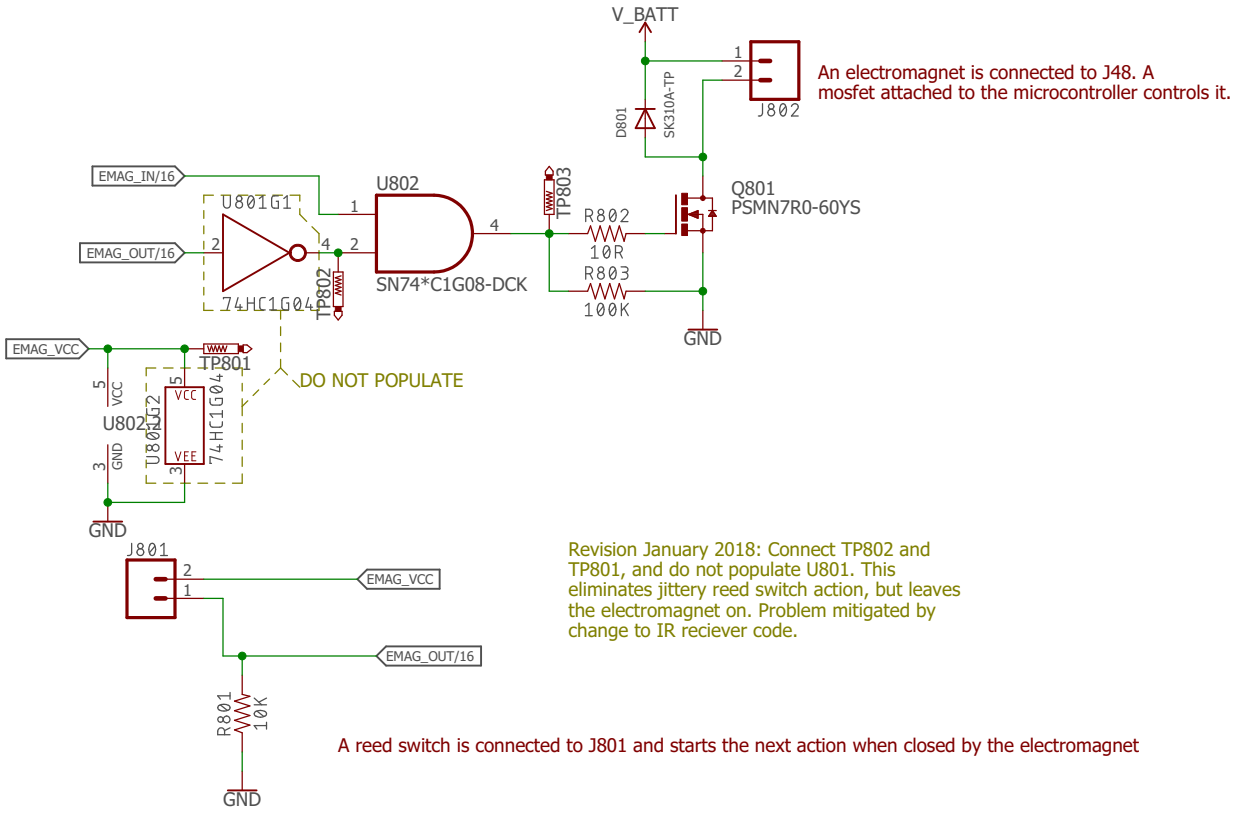

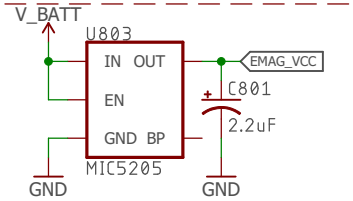

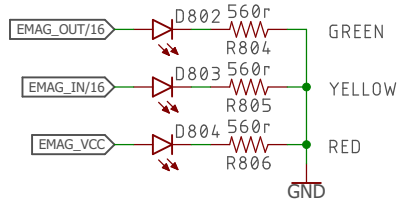

A reed switch triggers the next action after it is closed by the electromagnet.

"Activate a student-made electromagnet that begins the next action."

ELECTROMAGNET ACTION

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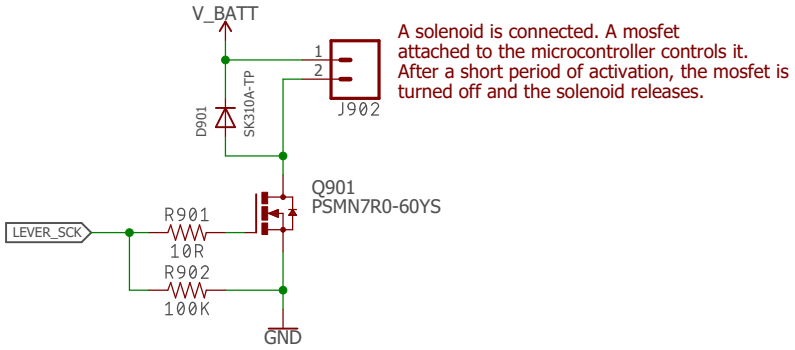
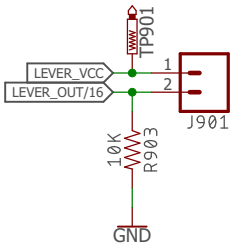


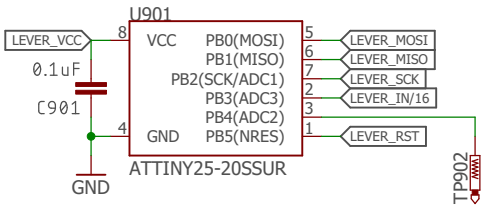
A solenoid is connected. A mosfet attached to the microcontroller controls it. After a short period of activation, the mosfet is turned off and the solenoid releases.

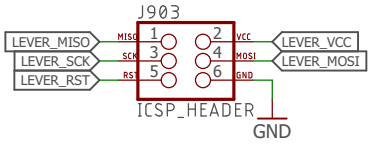


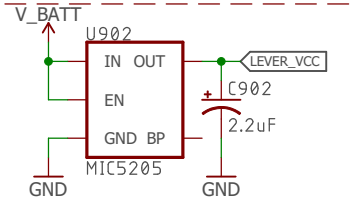
A normally open limit switch connected here is pressed by the levers., triggering the next action.

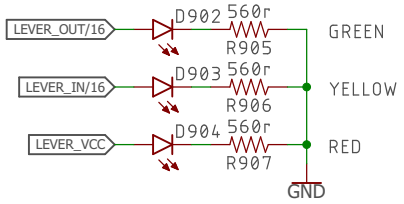
A reed switch triggers the next action after it is closed by the electromagnet.

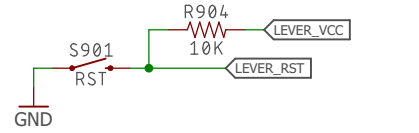
"Use the mechanical advantage of all 3 classes of levers in sequence to begin the next action."

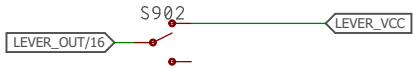












LEVER ACTION

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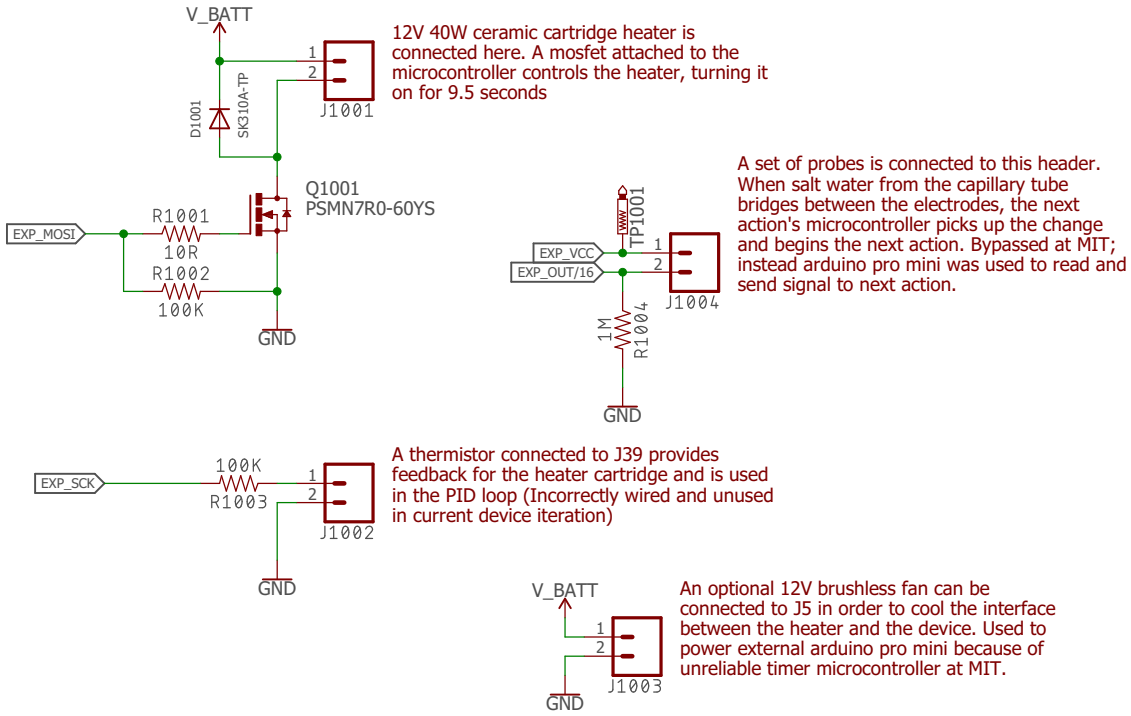

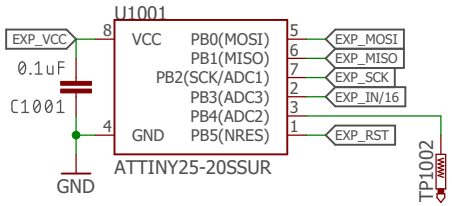

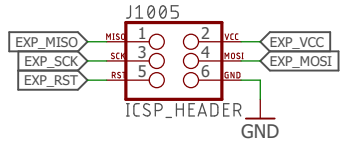

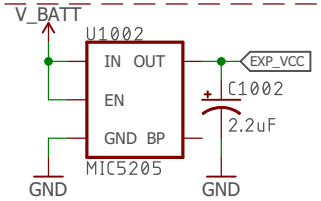

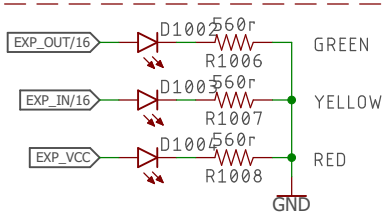

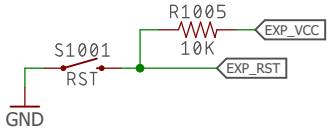

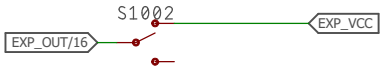

A sealed pressure chamber has an open capillary tube extending out of it that is filled with salt water. When a heater inside the pressure vessel turns on, it pushes the salt water out of the capillary tube and onto a pair of electrodes.

"Use a thermal reaction which expands a gas to activate the next action."

CLARIFICATION:
"Use a change in temperature which expands a gas to activate the next action."

GAS EXPANSION ACTION

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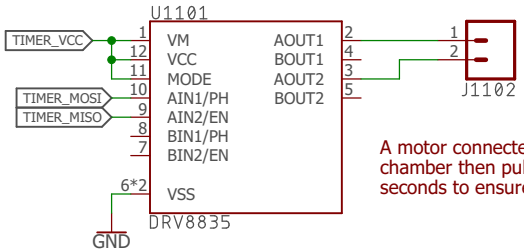
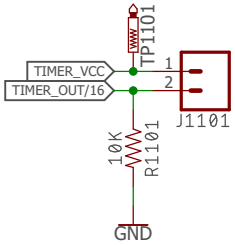
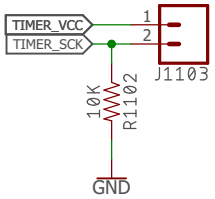


A motor connected to this header flips the pressure chamber then pulses back and forth for several seconds to ensure the alkaseltzer is mixing with the water.



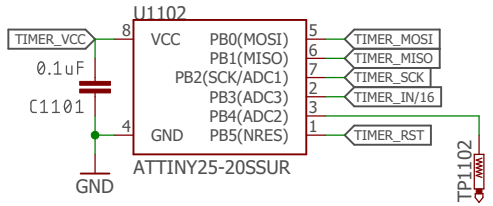
A normally open limit switch connected here is pressed by the expanding gas.

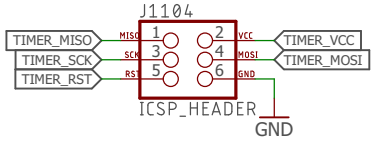


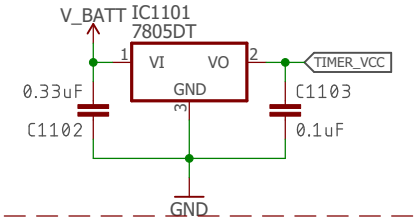
A normally open limit switch tells the motor driver when to shut off.

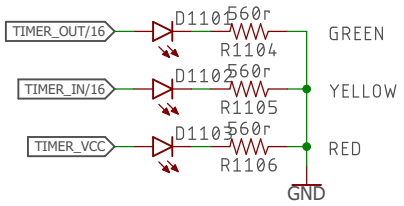
Alkaseltzer and water start uncombined in syringe becase of 3D printed "table" inside syringe which holds alkaseltzer up. Syringe flips, combining the two, and plunger slowly moves outwards.

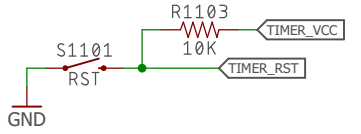
"To receive Bonus Points, participants must designate an action, either scorable or non-scorable, taking over 30 seconds that does not use electricity or springs for power."

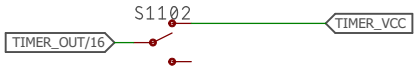












CHEMICAL TIMER

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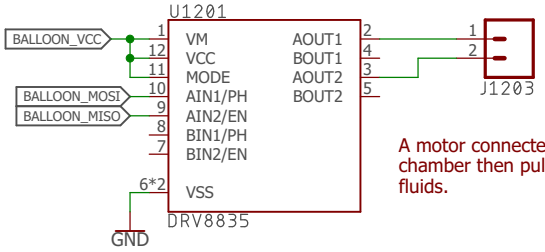
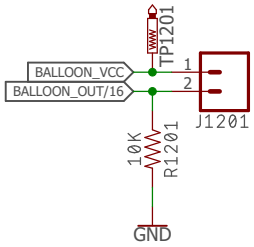
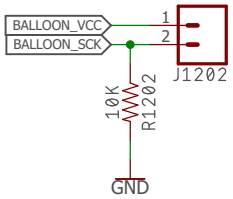


A motor connected to J40 flips the pressure chamber then pulses back and forth to mix the fluids.



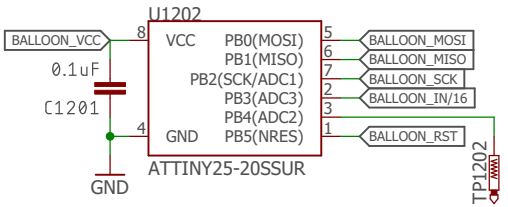
A normally open limit switch connected to J7 is pressed by the expanding balloon.

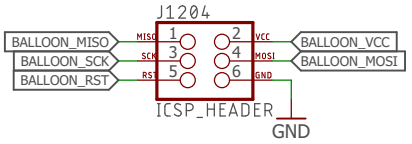


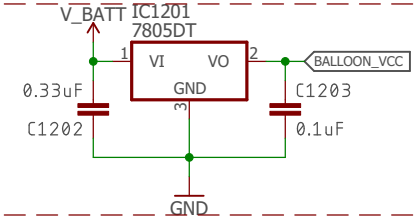
A normally open limit switch tells the motor driver when to shut off.

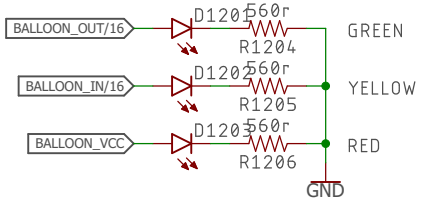
Syringe with baking soda filled basket attached to plunger is filled with 30% warm vinegar. When syringe is flipped, the two react and the resulting reaction inflates a balloon which hits a limit switch 20cm away.

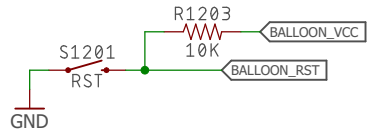
"Use a chemical reaction that inflates a balloon so that the balloon strikes an object that originally was at least 20 cm away from the balloon, so that the action of striking the object continues the sequence of events."

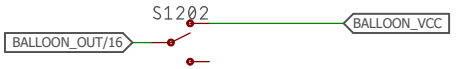












BALLOON ACTION

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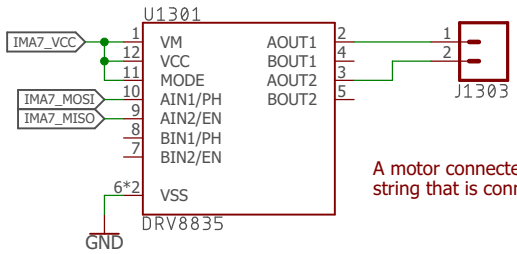
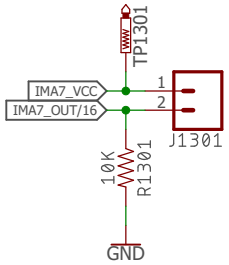
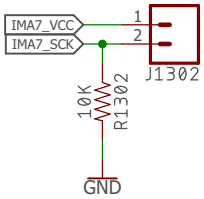


A motor connected here rotates, pulling the string that is connected to the mass

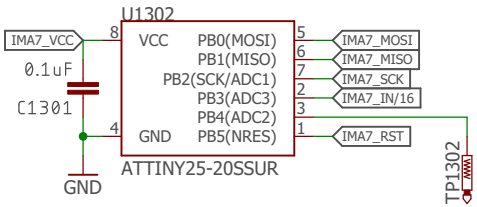


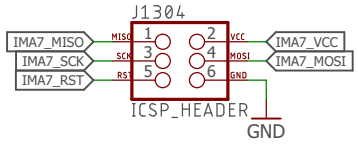
A normally open limit switch connected here is pressed by the mass as it lifts

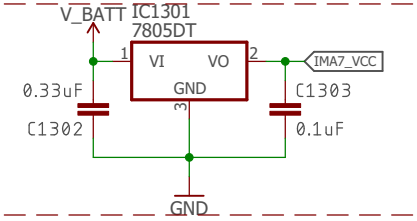
A normally closed limit switch connected to this header is pressed by the mass as it raises

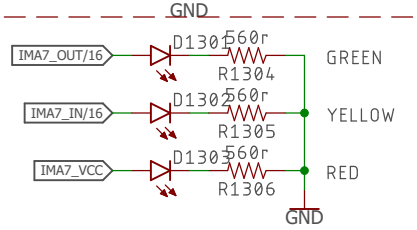


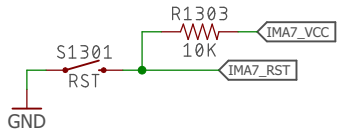
100uF, 25V capacitor was added following MIT invitational because of jerky motor performance. Connected between IMA7_VCC and GND on ICSP header on rear of board.

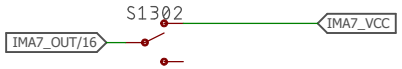












The pulley system, powered by the motor, lifts a mass up 10cm and hits two limit switches, one turns off the motor and the other triggers the next action.

"Use a Pulley system with an ideal mechanical advantage (IMA) of at least 7, that lifts an object that is at least 500 g at least 10 vertical cm before the object initiates the next action."

IMA 7 PULLEY ACTION

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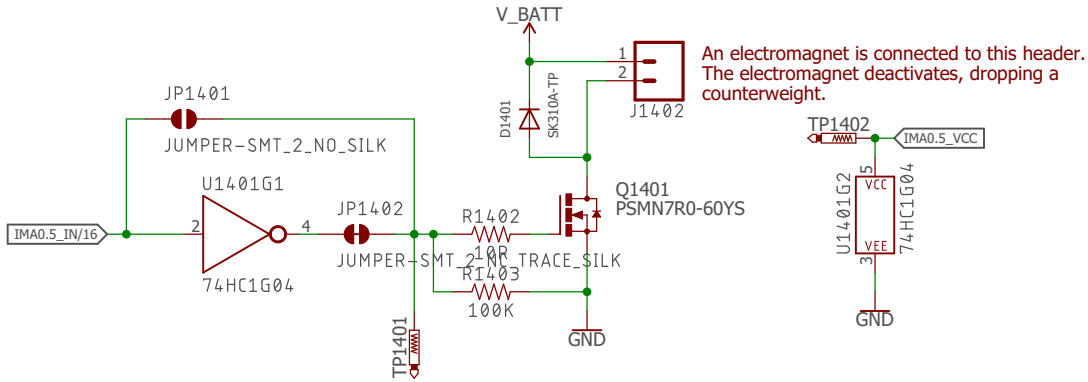

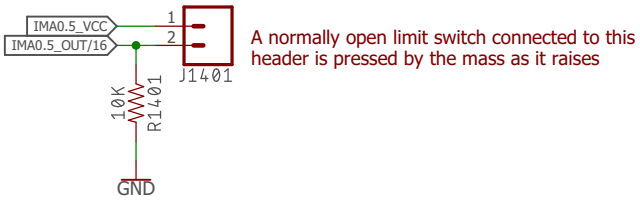

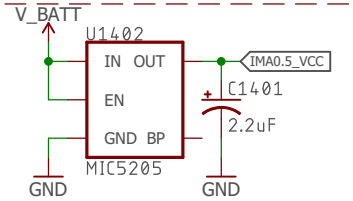

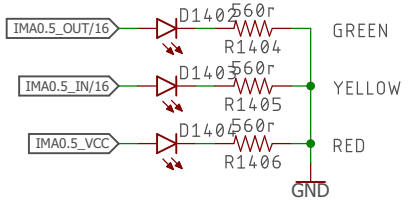

A counterweight is released by an electromagnet, which drops and pulls up a 500g mass. The mass raises 10cm then hits a limit switch, triggering the next action.

"Use a Pulley system that has an ideal mechanical advantage (IMA) of 0.50 that lifts an object that is at least 500 g at least 10 vertical cm before the object initiates the next action."

IMA 0.5 PULLEY ACTION

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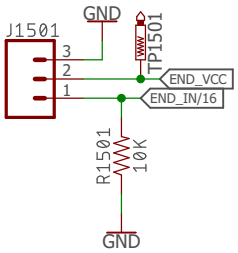
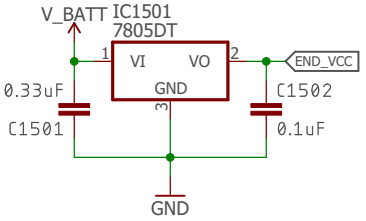
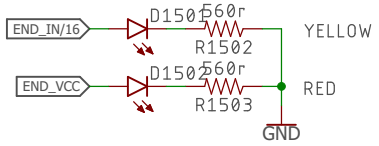


Previous transfer triggers DFrobot sound recording module (connected to J6), which then plays the end recording.





"The device must play a recording of the phrase "The End" to signal the end of the run. This phrase must be clearly audible, and demonstrated for the judges prior to the run."

END TASK

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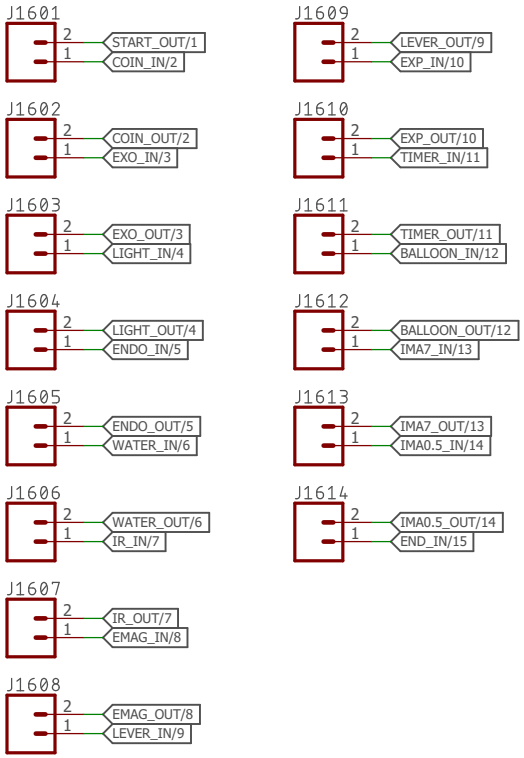

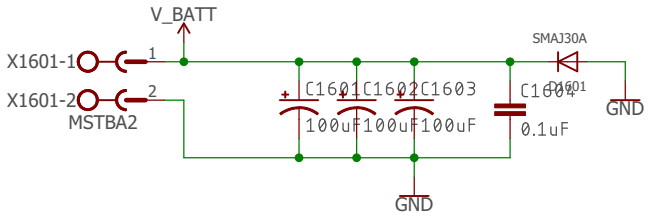

Power and Inter-Action

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