

The Electrical Box Details

The electrical box is an important part of the car. It is the device which controls whether power should go from the battery to the motor. That connection is determined by an Arduino which reads an input from a chemical reaction, which is the timer, and then allows power to flow to the motor depending on the state of the chemical timer. The box also has two LED's on the front of it. The blue LED with an 'i' below it signifies that the board is 'ready' and is in its looping state. The green LED with a motor icon below it will turn on if the motor should be going. This is helpful in debugging if a connection is not properly hooked up or if the box is not set up fully.

The box is designed to be easy to setup and use. There are four female banana plugs on one side of the box. They come in two pairs, one red and one black for each pair. The pair which has a motor icon below it is meant to be hooked up to the motor and the one with the battery icon below it should be connected to the power source. In both cases, the positive (red banana plug) of the battery/motor should be connected to the positive on the box while the negative (black banana plug) of the battery/motor should be hooked up to the negative of the box. Since the motor is bidirectional, it does not matter how this is hooked up. The direction of the motor is the only thing which changes if it is hooked up the other way. This does not matter too much but we want the motor to go in the right direction on the first attempt. The battery connection on the box is NOT bidirectional and will not work if it is hooked up the wrong way. This is because the box uses a transistor to allow power from the battery to flow to the motor. If the battery is hooked up the wrong way, then even if a high signal was sent to the transistor (telling it to be on), it will never be able to turn on. This is due to how the transistor is made: it will not allow the flow of electrons unless the gate is above a certain threshold in relation to the source and drain. Since

they would be flipped, that threshold will never cross and it will not run. There is also a chance that it would damage the Arduino as well.

The box also has different functions which are activated by the different button switches on the side of it. The first red switch with an Arduino logo below it allows for a 9V battery to be connected to the Arduino to power it. The other red switch with a motor symbol below closes the circuit of the battery. If this switch is off, no matter what state the motor should be due to the Arduino, no voltage will flow from the battery since there is not a closed circuit from the battery to the motor. This is useful so that we do not drain the battery faster than we want to. There are also two green buttons on the box. One of them controls whether the Arduino is checking the digital or analog input connection. If the switch is off, it check the digital connection, if it is on, it checks the analog connection for if the motor should be running or not. The other switch is called the Smart control switch and controls the different functions the box has.

There are a total of four different modes which the box has: Normal mode, Smart Control Mode, Always On Mode, and Logger Mode. Normal mode is activated by leaving the smart control switch (SCS) in the off state when the board boots up and then stays in the off state while the board is running. In this mode, the motor's state will match the input control's state. The Always on mode is activated by first going into Normal mode and then turning on the SCS. In this mode, the motor will always be on regardless of the input control's state. This is useful for when a power team wants to test but does not want to worry about making sure the input control is in the on state.

The third mode is the Smart Control mode. This state is activated by having the SCS in the on state when the Arduino boots up and then have the SCS stay in the on state when the board is running. This state also uses the button which is on the front of the box. In this state, the motor will not turn on until the button in front is pressed. Once that button is pressed, the motor

will stay on until the input control is in the off state for a short period of time. Once input control is in the off state for a majority of the current checking period, the motor will not turn back on even if the input control says it should turn back on. It is then reset when the button in front is pressed. This is helpful for reactions which stay in the on state for a period of time and then turn off when we want it to turn off but then go back to the on state after a little bit of time (bell shaped reactions where we want to stop at the peak). It is meant to be a safety measure for unstable reactions. The fourth mode is the Logger mode and has not been fully implemented yet. It is activated by going into the Smart Control Mode and then having the SCS in the off state when the board is running. This mode will allow for the Arduino to take data of the battery and distance but this has not been fully implemented yet.

The control input is from a digital or analog input. The analog input uses an ambient light sensor hooked up with a voltage divider to the Arduino. The Arduino then reads the value which will be from 0V to 5V. Currently if it detects anything above 0V, the control input signal is considered to be on. This is not perfect due to the noise which is inherent in electronic systems. This is currently implemented in the box but is not being currently used. The other control input which is being primarily used is the digital light sensor. A digital light sensor will send a digital signal to the Arduino of whether the motor should be on or off based off of the reaction. The Arduino will then process the input of the control input which is selected from the analog/digital button.

These are the different features of the current box. In the future, we plan to create a printed circuit board with Arduino Nano instead of a protoshield with an Arduino uno. This will help decrease the footprint of the electrical system and hopefully allow us to add more cool features.