Project 1B - Traffic Light Protoboard
Rapid Prototyping & Fabrication

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Introduction

This exercise transitions the breadboarded circuit from the last exercise to a protoboard. We were provided with a kit of parts, which included three 220Ω axial resistors, a through-hole six-position 100-mil-pitch 90° pin header, and three through-hole LEDs (red, yellow, and green). Finally, we were provided with the following schematic:
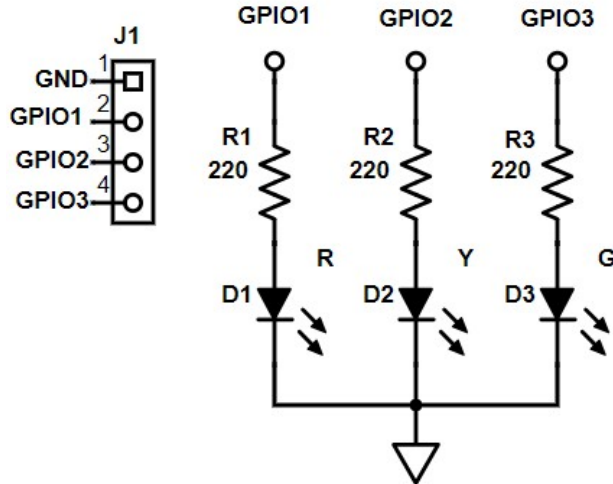
The goal of the completed board is to have a common ground pin and individual power pins for each LEDs. This allows for independent control of the LEDs. The components are all to be permanently affixed to the protoboard with solder. In doing so, our prototype will be more durable than a simple breadboard layout.

Requirements

1. Traffic light LEDs
    1. Traffic light shall have three (3) LEDs
    2. The top LED (furthest from pin header) shall be red
    3. The middle LED shall be yellow
    4. The bottom LED (closest to pin header) shall be green
    5. All LEDs shall have a 220Ω resistor connected in series to the power connection
2. Traffic light header
    1. Header shall be 1 row, 6 positions, male (pins), 90-degree, through-hole mount, 100 mil pitch
    2. Header shall be extend from the short side of the board
    3. Pin 0 shall be a common ground pin
    4. Pin 1 shall supply +5V to the red LED
    5. Pin 2 shall supply +5V to the yellow LED
   6. Pin 3 shall supply +5V to the green LED

Procedure

First, we had to modify the protoboard and the pin header for them to mate properly. Since we are using stripboard as opposed to perfboard (MorePCB 2023), some of the pins would be shorted together through the pre-existing traces. We also had to remove two pins from the pin header, because the pins do not have a corresponding hole on the board.

Next, we attached the LEDs, with red on top, followed by yellow, and green at the bottom, closest to the pin header. This order matches traffic lights. Finally, we added the resistors and additional connections to match the circuit described by the schematic provided. The final board is seen below:
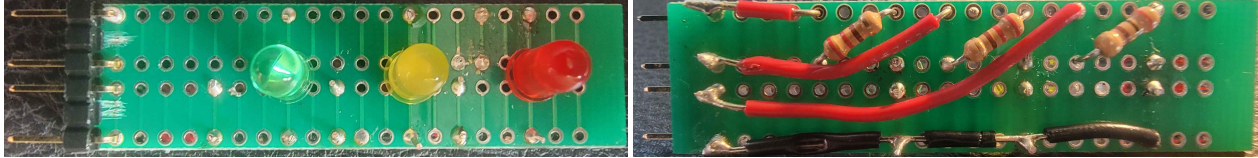
The board also worked as desired, with each LED lighting up when power is applied to its respective pin. The fully lit board is seen below:
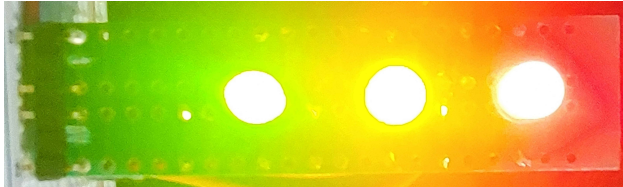
Reflection

My first key takeaway from this exercise was that planning is key to laying out a protoboard. Espeially, since we used stripboard, it is easy to forget that two adjacent pins are connected or that there are no rails. Instead, we have to make the rails.

Another takeaway I had was that holding the wire being soldered down with the helping hands can melt and leave and remove the insulation. Luckily, this did not cause a short on the board we made.

We also learned that stripboard is not ideal for mounting pin headers on the short end. To connect a pin header in this way, both the board and the header had to be modified. Cutting traces with a utility knife works, but is far from perfect. It leaves an opening in the solder mask that could easily short and cause a board failure.

Finally, we learned how to best create solder points along a wire. Our ground wire (shown in black above) is a single wire with slits cut into it. First a segment of wire was cut, and one end was stripped and soldered into the board. Then, we marked the point along the wire where we wanted the first slit to start. We used wire strippers to cut the insulation, and then slid the insulation down the un-soldered end to create the opening. Using small lengths of uninsulated wire, we were able to make a connection from the slit to a pad on the board.

References

MorePCB. 2023. "A Comprehensive Guide to Prototype Board." 2023. https://morepcb.com/a-comprehensive-guide-to-prototype-board/.