The magic of the 74HC595 shift register lies in how it controls each LED individually while still using only a few pins from the microcontroller.

How Can One 5V Input Control All LEDs?

The 74HC595 shift register **does not directly send the same 5V to all LEDs at once**. Instead:

1. It acts like a **switch** for each LED.
2. Each LED is connected to a separate output pin of the shift register.
3. The shift register switches each output pin **on or off** (HIGH or LOW) based on the binary data you shift into it.

This is achieved through the **current-sourcing and sinking capability** of the shift register. Here's what happens:

- When an output pin is HIGH, it provides 5V to the LED.
- When an output pin is LOW, it acts as a ground connection (0V).

Why Doesn't Voltage Drop When Multiple LEDs Are On?

The answer lies in **Ohm's Law**, proper circuit design, and how current flows:

1. **Voltage Is Constant Across Parallel Connections:**
    - Each LED is connected to its own output pin of the shift register.
    - These connections are effectively **parallel** from the perspective of the power supply.
    - In a parallel circuit, the voltage (5V) stays the same across all branches.
    - This means every LED sees the full 5V (or whatever is supplied to the shift register).
2. **Current Is Divided, Not Voltage:**
    - The shift register manages the current flowing through each pin separately.
    - Each LED draws only the current it needs (usually a few milliamps, limited by a resistor).
    - The power supply needs to provide enough current to drive all LEDs simultaneously, but the voltage remains constant.
3. **Resistors Prevent Overcurrent:**
    - Each LED is typically connected in series with a resistor.
    - These resistors ensure that the current through each LED is limited, preventing them from drawing more than they need and protecting the shift register from overload.

Key Takeaways

1. **5V Is Shared, But Current Is Divided:**
    - The 74HC595 doesn't "run out of voltage" because voltage is constant in a parallel circuit.
    - Instead, the power supply needs to handle the total current drawn by all LEDs (sum of currents through each branch).
2. **Each Output Pin Works Independently:**
    - The shift register can individually control the state (ON or OFF) of each pin, allowing fine-grained control over which LEDs are lit.
3. **The Role of Resistors:**
    - Each LED has its own resistor, ensuring proper current flow and preventing issues like brightness variations or damage.

Why Shift Registers Are Efficient

In your previous setup, each LED had its own microcontroller pin. This works but is **not scalable** when you need to control many LEDs. A shift register reduces the number of microcontroller pins needed (just 3 pins in your case) while allowing control of multiple outputs, making it much more efficient.

Maximum current from the 5V pin?