Common IC Breadboard Clock

by Frugha

In this Instructables I will explain how to make this Breadboard Clock using Common IC's.

Supplies:

- Common Cathode 7 Segment Display x6
- CD4026 IC x6
- CD4060 IC x1
- SN7476 IC x1
- SN7411 IC x1
- Push Button x2
- 220Ω Resistors x42
- 10kΩ Resistors x2
- 2.2kΩ Resistors x1
- 1MΩ Resistors x1
- 1N4007 Diode x2
- 100nF Ceramic Capacitor x1
- 33pF Ceramic Capacitor x1
- 5-45pF Trimmer Capacitor x1
- 32.768 KHz Crystal x1
- Breadboard x3
- 22AWG Solid Core Wire
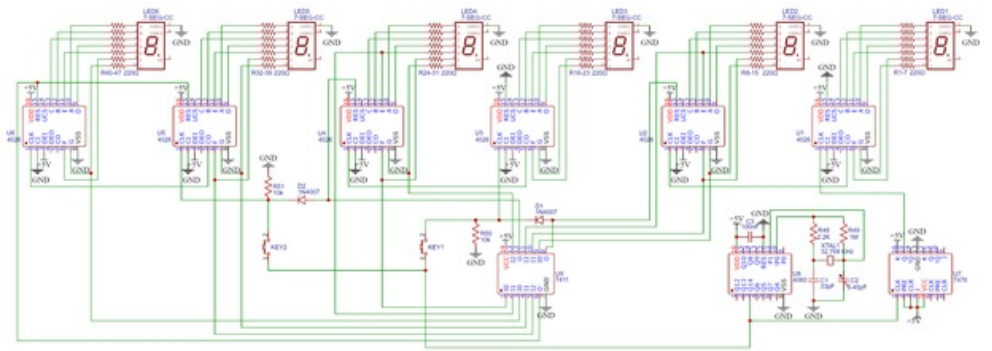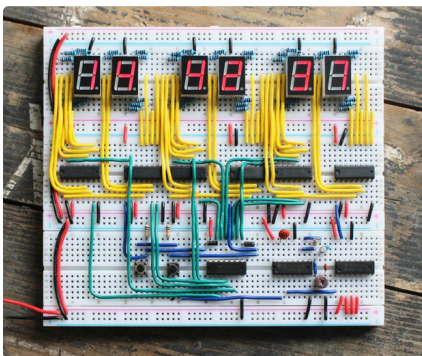
Step 1: Prepare the Breadboard

First you need 3 breadboards. Cut one side of 2 breadboards while making sure you don't cut the same side of.

Next you can snap the 3 boards in each other so it makes one big breadboard.

Connect all the power rails to each other using jumpers, this makes sure the whole board is powered using just one power supply.

Step 2: Add the 7 Segment Displays and Resistors

For this clock I used 6 Red 7 Segment Single Digit Common Cathode displays (5611AS).

Connect the cathode to the top power bar using some small jumpers.

If we connect the Segments to the 4026 IC's directly the

Vs = the source voltage = 5V
Vled = the LED voltage = 1.8V (see datasheet)
Iled = the desired LED current = 20mA (see datasheet)

R = (5 - 1.8) / 0.02 = 160Ω
The next higher easily available value is 220Ω so we will

leds will die so we need to connect a resistor to each segment.

To calculate the resistor value we will use the following formula: R = (Vs - Vled) / Iled.

R = the resistance

use that.

Add the resistors as seen in the images while making sure that none of the leads touch.
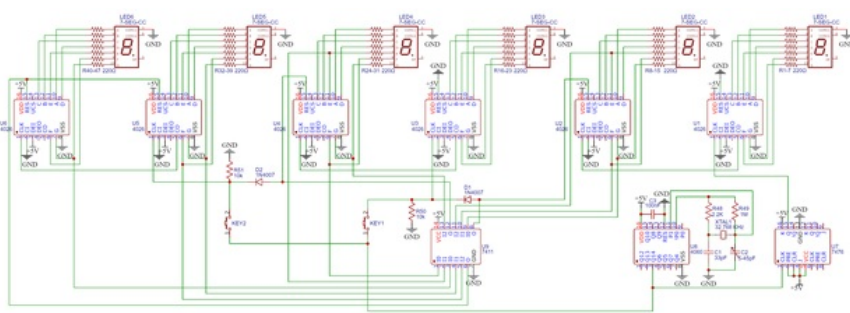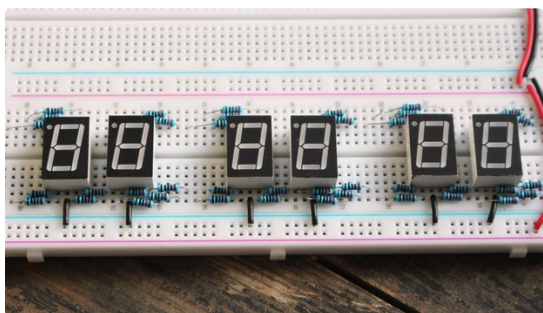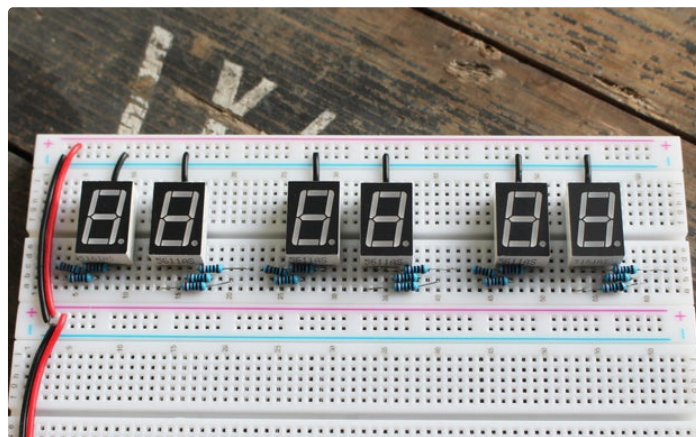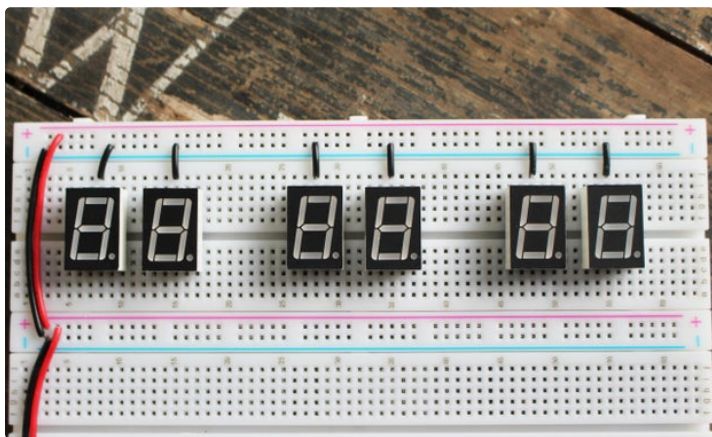
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Step 3: Add the CD4026B IC's

The 4026 IC is a counter with a 7-segment decoder that will address the displays.

Each 4026 can drive only 1 display, so to display the tens we need to connect the carry out pin of the ones to the clock pin of the tens:

Pin - 5 > Pin - 1 (From IC 1 > 2, 3 > 4, and 5 > 6)

Connect the rest of the IC's as following:

Pin - 2 > GND
Pin - 8 > GND

Pin - 15 > GND (Only on IC 1 and 3)
Pin - 3 > 5V
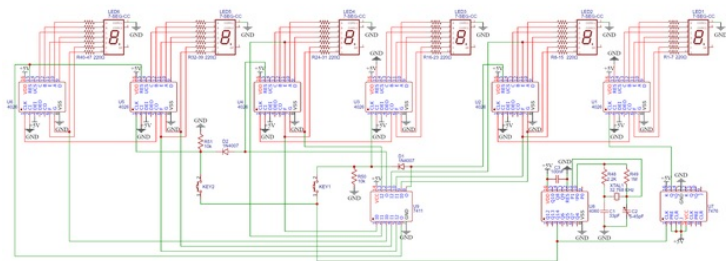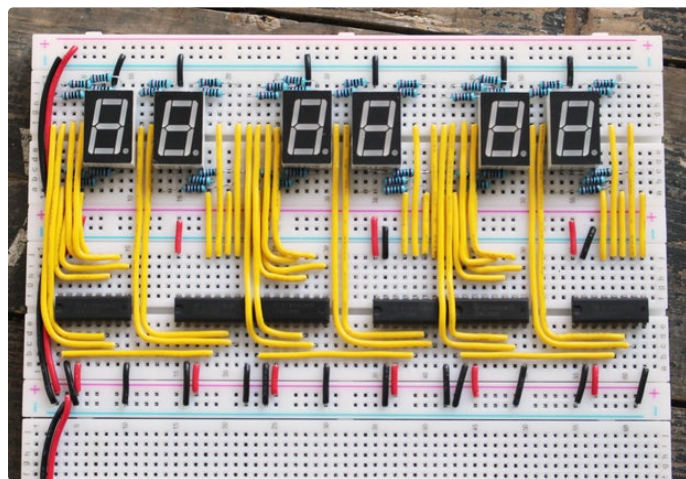Pin - 16 > 5V
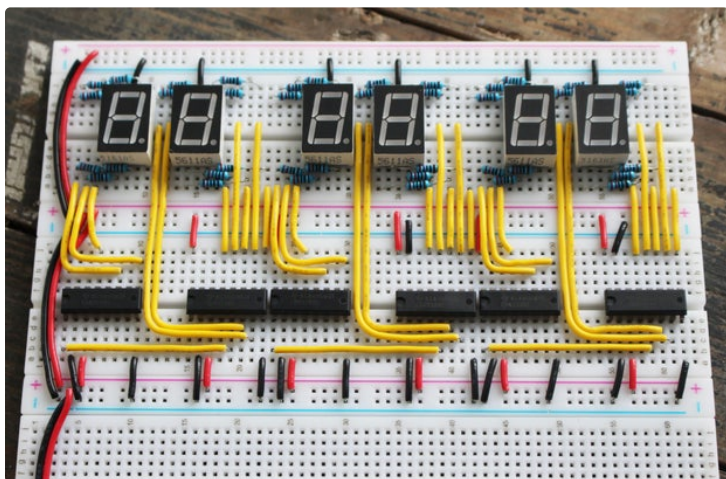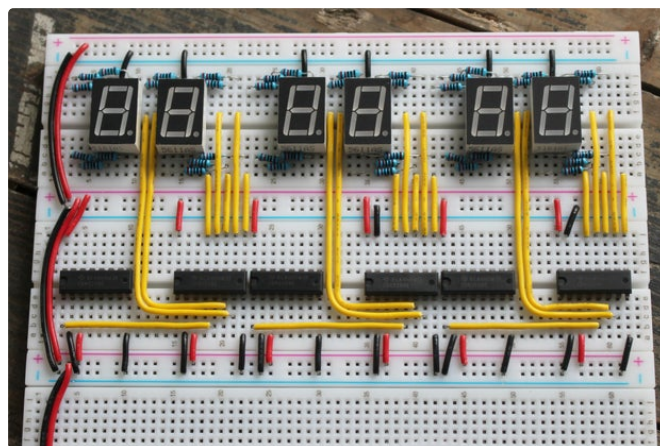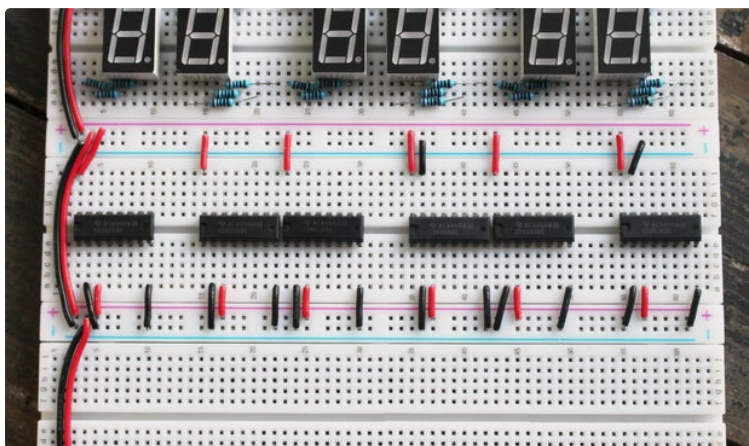
Segment - A > Pin - 10
Segment - B > Pin - 12
Segment - C > Pin - 13
Segment - D > Pin - 9
Segment - E > Pin - 11
Segment - F > Pin - 6
Segment - G > Pin - 7

Step 4: Make the Clock Signal

To make a 1Hz oscillator we are going to use a 32.768 KHz crystal because by halving it 15 times we will get a 1 Hz signal.

An easy way to half the signal is to use a binary counter like the 4060 IC.
This IC will half it 14 times so the output will be 2 Hz, to half it one more time we will use the 7476 IC.

The 7476 IC has two J-K Flip-Flops, if we look in the

datasheet we can see that by setting the PRE, CLR, J, K pins high we can toggle the output via CLK.

By using the 2 Hz signal as the clock the 7476 IC will half it and will make a 1 Hz signal, this output signal we will use as the clock of the first 4026 IC.

You can slightly adjust frequency by adjusting the trimmer until you read exactly 32.786 KHz.
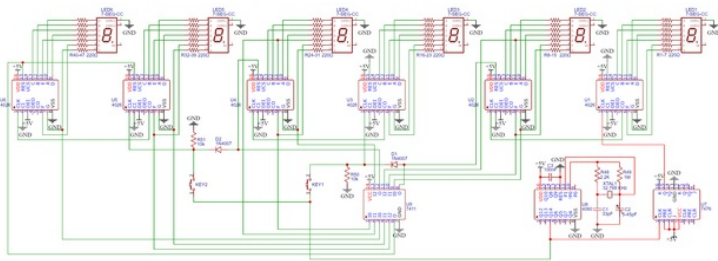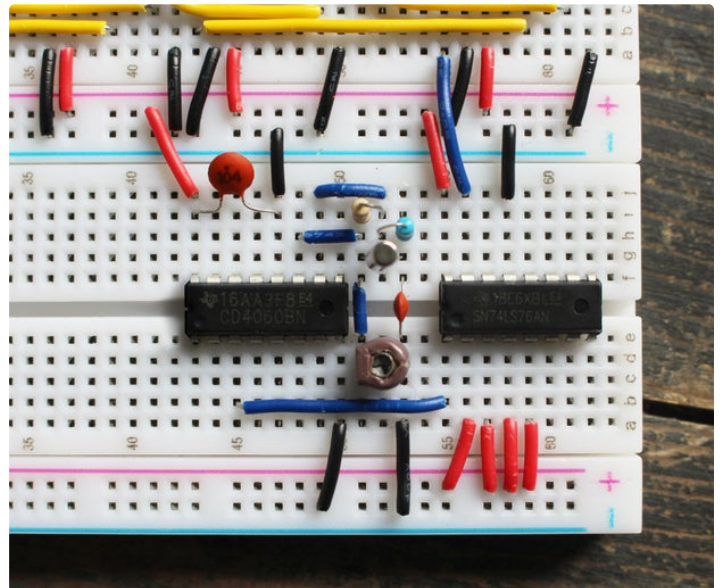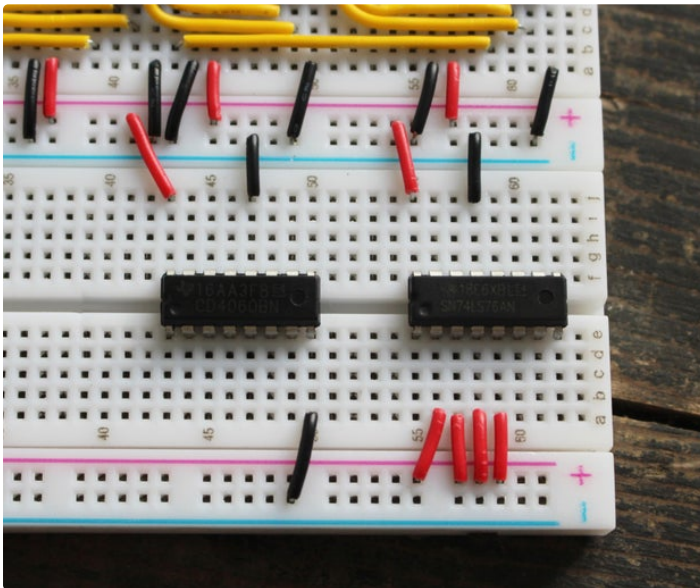
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Step 5: Add the Logic

To reset the seconds/minutes when it hits 60 and the hours when they hit 24 we need to add a 7411 IC.

The 7411 IC is an Tripple 3-Input And Gate, this means that the output only turns HIGH when the three inputs are HIGH.

For the seconds / minutes we can connect the E - F - G segments form the tens as Input and the Output as the reset for the tens.

For the hours we can connect the F - G segments from the ones and the G segment from the tens as Input and the Output as the reset for both the ones and tens.

This will cause the seconds / minutes to reset as soon as it hits 60 and the hours to reset as soon as it hits 24.
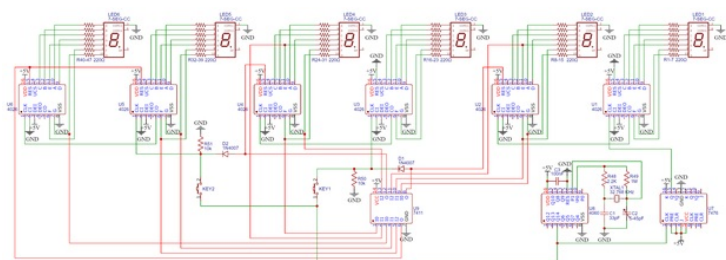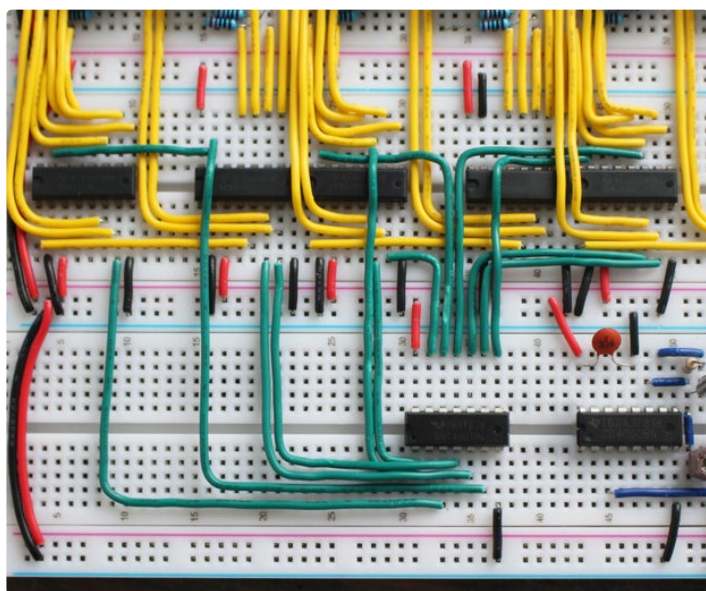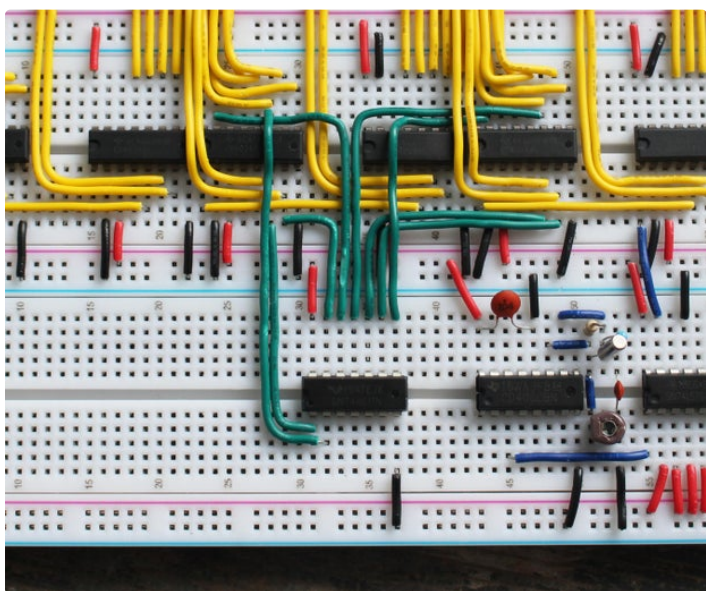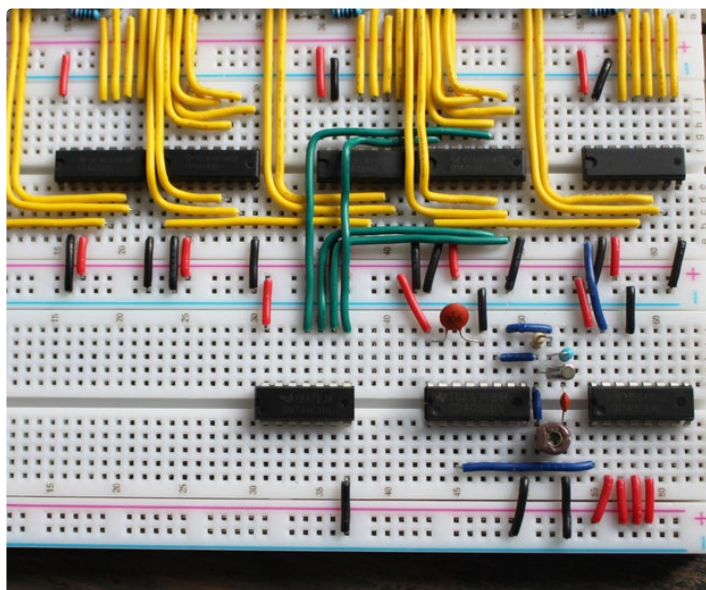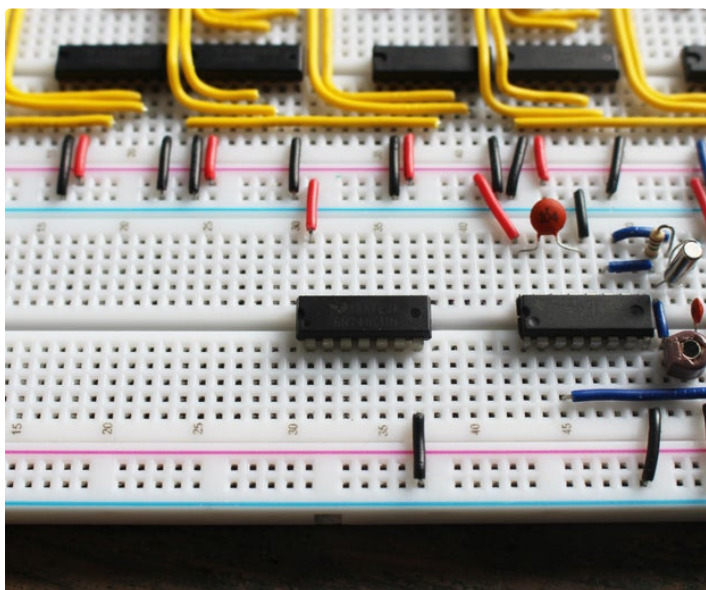
Step 6: Add the Buttons

To set the minutes / hours we need to add two buttons.

One side of the buttons are connected to the 2 Hz signal this way you can hold the buttons to increase the minutes / hours. The other side of the buttons are connected to the clock pin of the 4026 IC's.

The reset of the seconds / minutes will also connect to the clock pins of the minutes / hours using a diode.
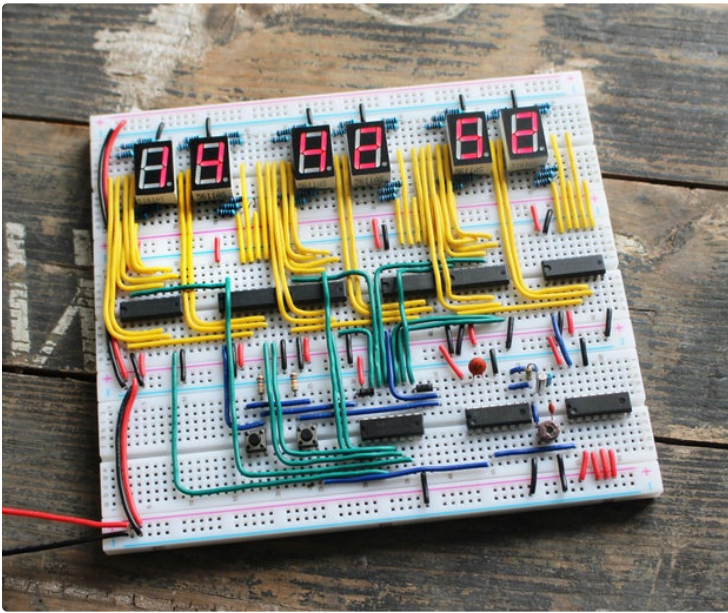
Because the clock pins float when the button isn't pressed we need to add a 10k pulldown resistor.
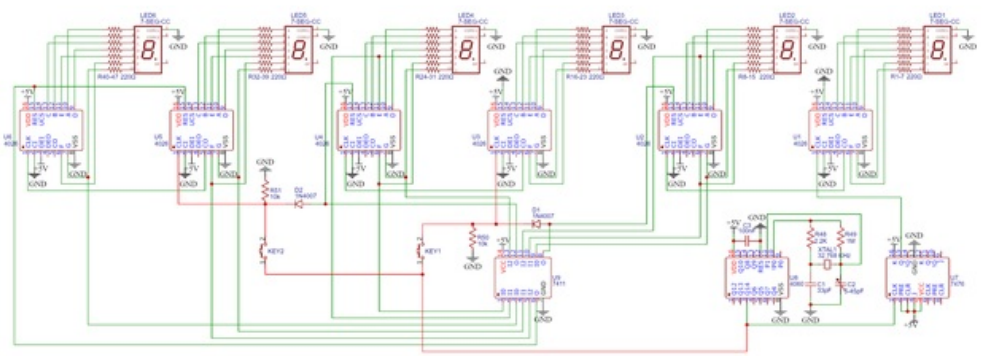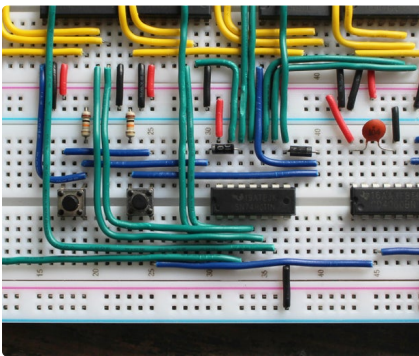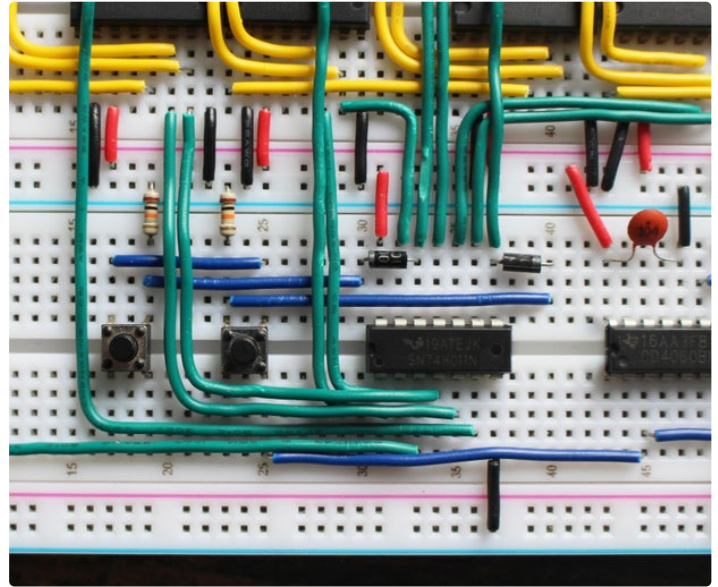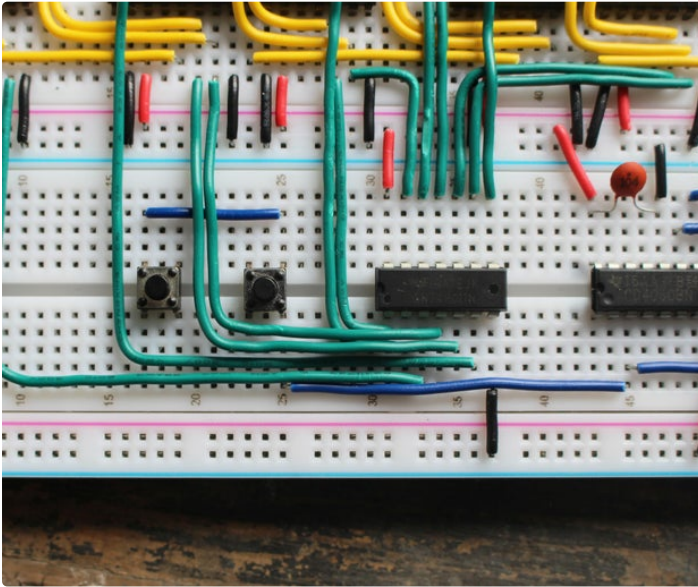
Step 7: Final

Finally connect a 5V power supply to the power rail and set the time with the buttons.

And you're done!!!

I love clocks and this one is interesting as it uses electronics only, no software. Just like the first electronic clock I built 50 years ago using TTL logic. Well done. I might be tempted to design a PCB and make this.