TEJ4M Circuit Portfolio

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Section 1

LED

Description

This circuit, when powered, lights up an LED indefinitely.

Components

- LED
- 870 Ohm Resistor

Part Purposes

- **LED**: The LED lights up to give an indication of the electricity flowing through the circuit. It has a positive and a negative terminal and is polarity sensitive and so it must go into the board in the right way.
- **Resistor**: The LED appropriate resistor resists the current so that not enough energy flows through that the LED will burn out.

Section 2

LED w/ switch

Description

This circuit controls if an LED is on or off by placing a button in the path between +5V and the LED. If the button is not pressed, the LED is off. If the button *is* pressed, then the LED turns on as the circuit is once again completed.

Components

- LED
- Button
- 870 Ohm Resistor

Part Purposes

- **LED**: The LED lights up and turns off depending if there is electricity flowing through. It lights up to show current passing through it.
- **Button**: The button interrupts the current flowing from +5V to the LED, breaking the circuit. By default, the button is depressed and the LED is off. When the button is pressed, the circuit is once again compeleted and the LED turns on.
- **870 Ohm Resistor**: The LED appropriate resistor resists the current so that not enough energy flows through that the LED will burn out.

Section 3

Smoothing Cap

Description

This circuit shows the capacitor's battery-like characteristics. When the button is pressed the capacitor charges up while the LED turns off. When the button is depressed, current stops flowing from the button and instead flows from the capacitor into the LED. The LED then slowly fades away.

Components

- Button
- 870 Ohm Resistor
- 1mF Capacitor
- LED

Part Purposes

- **Button**: The button controls the flow of electricity from +5V to the rest of the circuit. When pressed, the circuit is compleeted and current can flow through. When depressed, no more electricity is added to the cirucit.
- **870 Ohm Resistor**: The LED appropriate resistor resists the current so that not enough energy flows through that the LED will burn out.
- **1mF Capacitor**: When the button is pressed, the capacitor starts charging up. When the button is depressed, no more electricity comes from +5V and so the capacitor starts discharging. As it discharges, the voltage lowers following the capacitor's characteristic curve, which is observable through the exponential dimming of the LED.
- **LED**: The LED is used to indicate electricity flowing through that point in a circuit at any specific time. # 555 Bistable

Description

Using the 555 Timer IC, we make a bistable circuit, meaning a circuit in which there are two non-volatile states. When one button is pressed, the LED turns off and stays off indefinitely. When the other button is pressed, the LED turn on and stays on indefinitely.

Components

- 2x 10k Ohm Resistors
- 1x 870 Ohm Resistor
- LED
- 2x Button
- 1x 555 Timer

Part Purposes

- **2x 10k Ohm Resistors**: These resisotrs are for pulling each button up and down to different voltages. This creates the potential difference which is used to activate the threshold and trigger pins on the 555 Timer.
- **1x 870 Ohm Resistor**: The LED appropriate resistor resists the current so that not enough energy flows through that the LED will burn out.
- **LED**: The LED is used to indicate electricity flowing through that point in a circuit at any specific time.

Part Purposes Cont'd

- **2x Button**: The two buttons are used to interrupt the circuit between +5V and ground. When pressed, they send electricity to the 555 timer showing that they want a specific state enacted.
- **1x 555 Timer**: This is where all the logic is happening. When pin 2 (trig) is pulled down, the voltages powering the comparators will change, which means the flip-flop will change as well. In this case, it ends up powering the output pin, which powers the LED. This will cause the 555 to turn the LED on. When pin 6 (thresh) is pulled up, this resets the IC to it's initial state, with the LED off.

Section 4

Dark Detector

Description

This circuit looks for darkness. Using a photosensitive resistor, it will detect when it is dark enough and then the LED will light up.

Components

- 330k Ohm Resistor
- 870 Ohm Resistor
- LED
- BJT Transistor
- Photosensitive Resistor

Part Purposes

- **330k Ohm Resistor**: The 330k resistor lowers the voltage by an immense amount so that the miniscule voltage changes caused by the photosenstive resistor can be seen. In this case, pulls the voltage down by a lot before it touches the photosensitive resistor.
- **1x 870 Ohm Resistor**: The LED appropriate resistor resists the current so that not enough energy flows through that the LED will burn out.
- **LED**: The LED is used to indicate electricity flowing through that point in a circuit at any specific time.

Part Purposes cont'd

- **BJT Transistor**: Depending on the brightness of the room, the BJT will receive different voltages in the voltage bridge between the 330k and photosensitive resistors at its base. If this voltage is high enough, the BJT transistor will activate and current will be allowed to flow from the collector to the emitter. This completes the circuit so that the LED will turn on.
- **Photosensitive Resistor**: It is non-polarized. When it is bright, the resistance is lower. In this circuit it changes the proportion between this resistor and the 330k resistor, creating a variable voltage bridge in between them. If it is bright, the LED turns off.

Section 5

Oscillating Flasher

Description

Using capacitors, this circuit allows for a smooth fading between two different LEDs. This circuit emulates the 555 astable circuit. It acts like two common-emitter amplifier stages pasted on top of each other.

Components

- 2x 870 Ohm Resistors
- 2x LEDs
- 2x BJT Transistors
- 2x 50uF Capacitors
- 2x 22k Resistors

Part Purposes

- **2x 780 Ohm Resistors**: The LED appropriate resistors resists the current so that not enough energy flows through that the LED will burn out.
- **2x LEDs**: The LEDs are used to indicate electricity flowing through that point in a circuit at any specific time.
- **2x BJT Transistors**: A transistor's base is turned on by the output of a capacitor. Once the base is turned on, the current flows through the collector and emitter, thereby allowing the capacitor on that side to discharge, which turns on the base of the other transistor. This continues to repeat indefintely and has not stable state.
- **2x 50uF Capacitors**: The capacitors continue to charge and discharge based on whether or not the path of least resistance to ground is through the capcitor (e.g. the transistor on that side is not open). The capacitors have no stable state.
- **2x 22k Resistors**: These provide a constant source of power higher than LOW but lower than HIGH. It is just low enough that when the

Section 6

Touch Current Amplifier

Description

This circuit toggles an LED on and off indirectly by conducting electricity between power and the base of a transistor. When you touch both ends, your body becomes the conductor powering the base, allowing current to flow from the LED all the way to ground.

Components

- 2x 870 Ohm Resistors
- LED
- 2n2222 Transistor

Part Purposes

- **2x 780 Ohm Resistors**: The LED appropriate resistors resists the current so that not enough energy flows through that the LED will burn out. In addition, prevents too much current from flowing through your body.
- **LED**: The LED is used to indicate electricity flowing through that point in a circuit at any specific time.
- **2n2222 Transistor**: When a human touches the end of the unconnected resistor and the base of the transistor, the base has enough voltage and so the transistor allows current to flow through.

Section 7

Remote LED

Description

Components

- 780 Ohm Resistor
- LED
- Button
- 22k Ohm Resistor
- 2N2222 Transistor

Part Purposes

- **780 Ohm Resistor**: The LED appropriate resistor resists the current so that not enough energy flows through that the LED will burn out. In addition, prevents too much current from flowing through your body.
- **LED**: The LED is used to indicate electricity flowing through that point in a circuit at any specific time.
- **Button**: Used to interrupt the flow of current from +5V to the base of the transistor. When the button is pressed, the LED is on. When it is depressed, the LED is off.
- **22k Ohm Resistor**: The LED is used to limit current and voltage to an acceptable level that does not destroy the transistor.
- **2N2222 Transistor**: When its base is powered, it allows energy to flow through from the collector to the emitter, completing the LED circuit, turning the LED on. When the base is not powered it interrupts that circuit and turns the LED off.

Section 8

555 Monostable

Description

When the button is pressed the one LED turns off while the other LED turns on. This is continued for a while until a capacitor charges up high enough that it switches back to its initial state.

Components

- 870 Ohm Resistor
- LED
- 330k Ohm Resistor
- 22k Ohm Resistor
- 50 uF Capacitor
- Button

Part Purposes

- **780 Ohm Resistors**: The LED appropriate resistor resists the current so that not enough energy flows through that the LED will burn out. In addition, prevents too much current from flowing through your body.
- **LED**: The LED is used to indicate electricity flowing through that point in a circuit at any specific time. Glows proportional to the Capacitor's Charge.
- **330k Ohm Resistor**: Used to pull down the voltage a lot before entering the threshold and discharge pins on the 555 and the capacitor.

Part Purposes cont'd

- **22k Ohm Resistor**: Pulls the voltage down a bit before entering the 555 timer's trigger pin or before it goes through the button to ground.
- **50 uF Capacitor**: Accepts varying amounts of power, thereby changing the voltage given to the threshold/discharge pins on the 555 timer. When the button is pressed, the capacitor starts accepting current and charges up until it is full. Then, when full, it releases all of its electricity to ground. The LED's brightness is proportional to the charge of this capacitor.
- **Button**: Pulls the trigger pin on the 555 down to trigger the monostable operation to start.

Section 9

Charging Capacitor

Description

By default, LED1 is on. When the button is pressed LED1 turns off and LED1 increases proportionally to the charge stored in the capacitor. Once the capacitor is done charging and discharges to ground, LED1 turns back on and LED2 turns off.

Components

- 100 Ohm Resistor
- 2x 870 Ohm Resistors
- 2x LEDs
- 2x 2N2222 Transistors
- Button
- 1mF Capacitor

Part Purposes

- **100 Ohm Resistor**: Pulls the voltage down and limits the current flowing to the base of a transistor and to the capacitor.
- **2x 780 Ohm Resistors**: The LED appropriate resistors resists the current so that not enough energy flows through that the LED will burn out.
- **2x LEDs**: The LEDs are used to indicate electricity flowing through that point in a circuit at any specific time.

Part Purposes cont'd

- **2x 2N2222 Transistors**: By default both transistor's bases are open leading to one LED being on and the other being off. When the button is pressed this allows the capacitor to discharge. Since the electricity isn't flowing towards the gate of the transistor anymore it shuts off the emitter to that transistor, which shuts off the base to the other transistor as well. This turns the other LED on while the capacitor continues charging up.
- **Button**: Temporarily ground the electricity from the 100 Ohm resistor, allowing the capacitor to start discharging.
- **1mF Capacitor**: As it charges/discharges it changes the amount of power it can accept, meaning that the input ot the base of one of the transistors is also changed.

Section 10

Practice Circuit

Description

The circuit consists of two astable clocks using 555 Timer ICs. The shorter clock will flash the lights, whilst the longer clock will change the pair of LEDs being affected by the flashing.

Components

- 4x 870 Ohm Resistors
- 4x LEDs
- 5x 22k Ohm Resistors
- 2x Diodes
- 2x 330k Ohm Resistors
- 2x 2N2222 Transistors
- 2x 555 Timer ICs

Part Purposes

- **4x 780 Ohm Resistors**: The LED appropriate resistors resists the current so that not enough energy flows through that the LED will burn out.
- **4x LEDs**: The LEDs are used to indicate electricity flowing through that point in a circuit at any specific time.
- **5x 22k Ohm Resistors**: Uses:
  1. Divide voltage for 1st timer
  2. Lower the voltage from outputs of 555 timer and +5V to something that is safe for the bases of the transistors
- **2x Diodes**: Ensures that it is very unlikeliy that energy would travel backwards from trigger or threshold into the discharge pin. Encourages the electricity to go through the capacitor.

Part Purposes cont'd

- **2x 330k Ohm Resistors**: Used to divide the voltage for the second timer.
- **2x 2N2222 Transistors**: Uses:
  1. On the shorter clock, give power to all 4 LEDs
  2. On the longer clock, selectively ground a set of LEDs to complete the circuit to get that set of LEDs to turn on.
- **2x 555 Timer ICs**: Makes an astable clock based on the resistors in the voltage divider between the discharge and the trigger/threshold pins. A higher resistance makes the clock go on for longer. For more information see the 555 Timer's description in the 555 Astable circuit.

Section 11

555 Astable

Description

Repeatedly flashes an LED on and off without human intervention.

Components

- 870 Ohm Resistor
- LED
- 50uF Capacitor
- 330k Resistor
- 22k Resistor
- 555 Timer IC

Part Purposes

- **780 Ohm Resistors**: The LED appropriate resistor resists the current so that not enough energy flows through that the LED will burn out. In addition, prevents too much current from flowing through your body.
- **LED**: The LED is used to indicate electricity flowing through that point in a circuit at any specific time.
- **50uF Capacitor**: Repeatedly charges up and discharges, changing the voltage given to the trigger and threshold pins on the 555 Timer.

Part Purposes cont'd

- **330k Resistor**: Pulls the voltage down a substantial amount before going to the trigger and threshold pins on the 555 timer.
- **22k Resistor**: Pull the voltage down a bit before giving energy to the discharge pin.
- **555 Timer IC**: Where most of the logic happens. Based on the voltage difference between the threshold and trigger pins, the comparators inside the IC will change the flip-flop, thereby changing the output, thereby turning the LED on and off.

Section 12

Diminishing Frequency Astable

Description

When the button is pressed, rapid pulses will start coming out of the output pin. Because of the capacitors, the pulsing won't stop immediately but will rather slow down until the output pin ends up outputing HIGH.

Components

- 2x 780 Ohm Resistor
- LED
- 2x 330k Ohm Resistor
- 4.7uF capacitor
- 50uF capacitor
- 555 Timer IC

Part Purposes

- **2x 780 Ohm Resistors**: The LED appropriate resistor resists the current so that not enough energy flows through that the LED will burn out. In addition, prevents too much current from flowing through your body.
- **LED**: The LED is used to indicate electricity flowing through that point in a circuit at any specific time.
- **2x 330k Ohm Resistor**: Divides the voltage up ensuring different voltages go to the Discharge pin and the trigger/threshold pins.
- **4.7uF capacitor**: The quick discharge/recharge cycle means
- 50uF capacitor
- **555 Timer IC**: Does the main logic

Section 13

Cylon Knight

Description

Using the 4017 IC, this allows for 6 LEDs to be pulsed sequentially to one end and back again.

Components

- 4017 IC
- 10 Diodes
- 6 LEDs
- 780 Ohm Resistor

Part Purposes

- **4017 IC**: Handles the addition/counting/logic part of the circuit. Every pulse, it increments from 0 to 9. When it tries to increment at 9, it rolls back to 0. This is what chooses which LED to turn on.
- **10 Diodes**: Ensures that if any current is emitted from the 4017 IC that it will go through the LED and not back towards the IC.
- **6 LEDs**: For displaying if electricity if flowing through that point at a moment in time.
- **780 Ohm Resistor**: Limits the current so that the LEDs don't get destroyed.

Section 14

Light Detector

Description

This circuit looks for brightness. Using a photosensitive resistor, it will detect when it is bright enough and then the LED will light up.

Components

- 330k Ohm Resistor
- 870 Ohm Resistor
- LED
- BJT Transistor
- Photosensitive Resistor

Part Purposes

- **330k Ohm Resistor**: The 330k resistor lowers the voltage by an immense amount so that the miniscule voltage changes caused by the photosenstive resistor can be seen. In this case, pulls the voltage down by a lot after it touches the photosensitive resistor.
- **1x 870 Ohm Resistor**: The LED appropriate resistor resists the current so that not enough energy flows through that the LED will burn out.
- **LED**: The LED is used to indicate electricity flowing through that point in a circuit at any specific time.

Part Purposes cont'd

- **BJT Transistor**: Depending on the brightness of the room, the BJT will receive different voltages in the voltage bridge between the 330k and photosensitive resistors at its base. If this voltage is high enough, the BJT transistor will activate and current will be allowed to flow from the collector to the emitter. This completes the circuit so that the LED will turn on.
- **Photosensitive Resistor**: It is non-polarized. When it is bright, the resistance is lower. In this circuit it changes the proportion between this resistor and the 330k resistor, creating a variable voltage bridge in between them. If it is bright, the LED turns on.