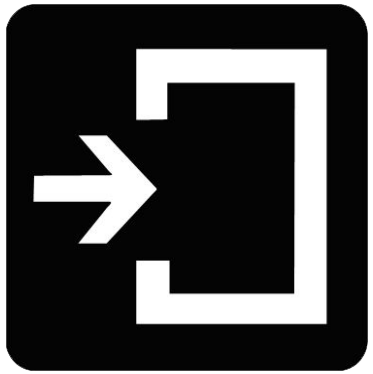
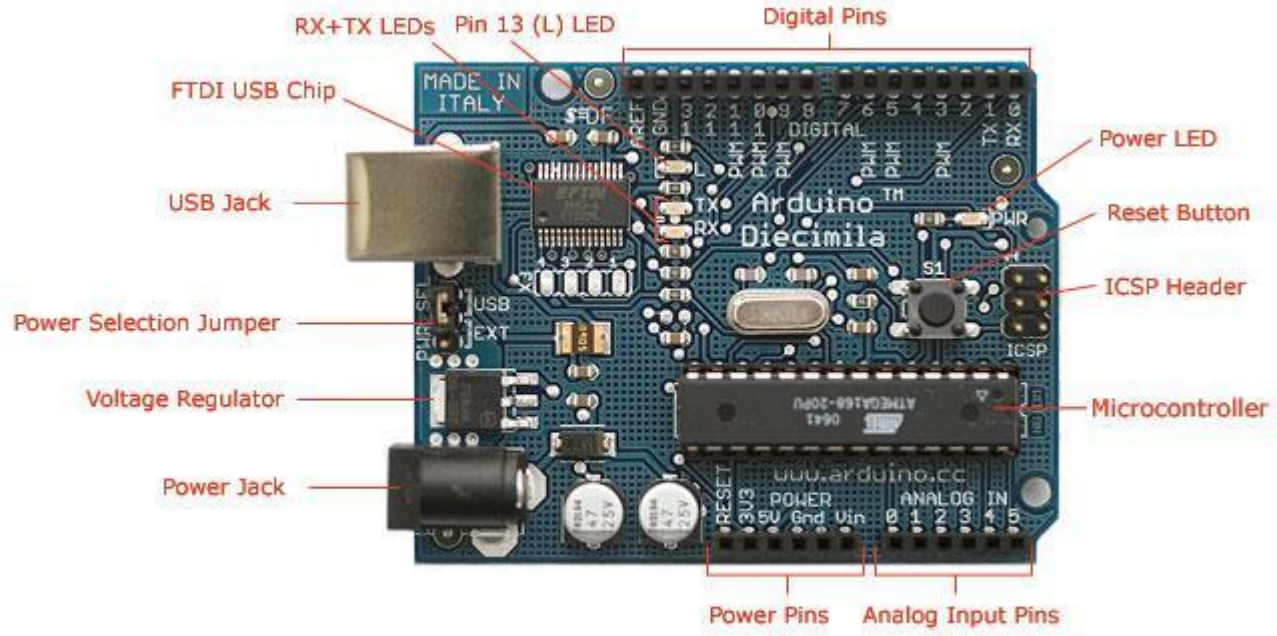
CREATE-IT
APPLIED
RESEARCH

(DIGITAL) INPUT



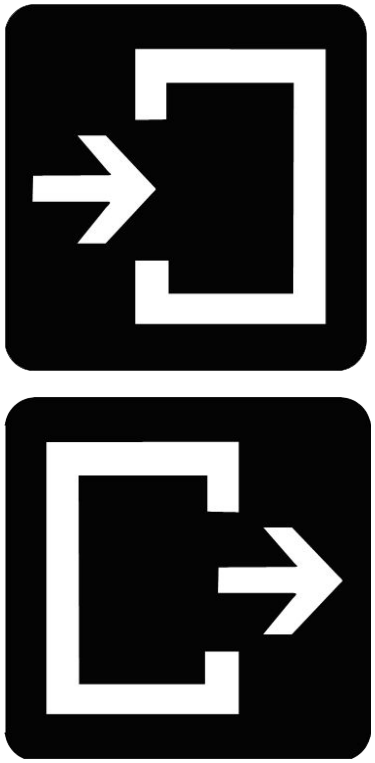
ARDUINO



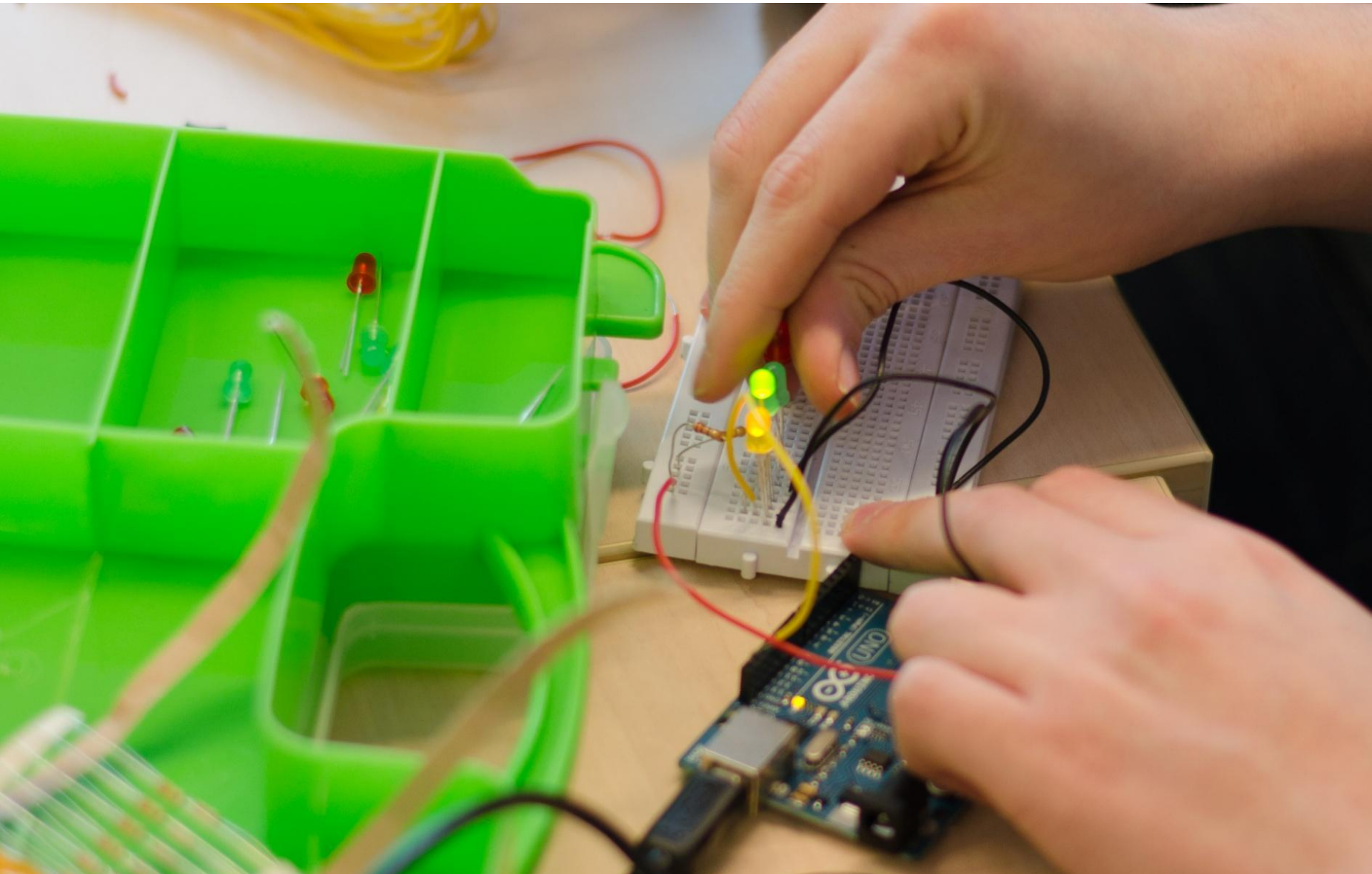
Photograph by SparkFun Electronics. Used under the Creative Commons Attribution Share-Alike 3.0 license.

Arduino Pins

- Digital (Input, Output)
  - RX
  - TX
  - PWM
- Analog Input



Digital output

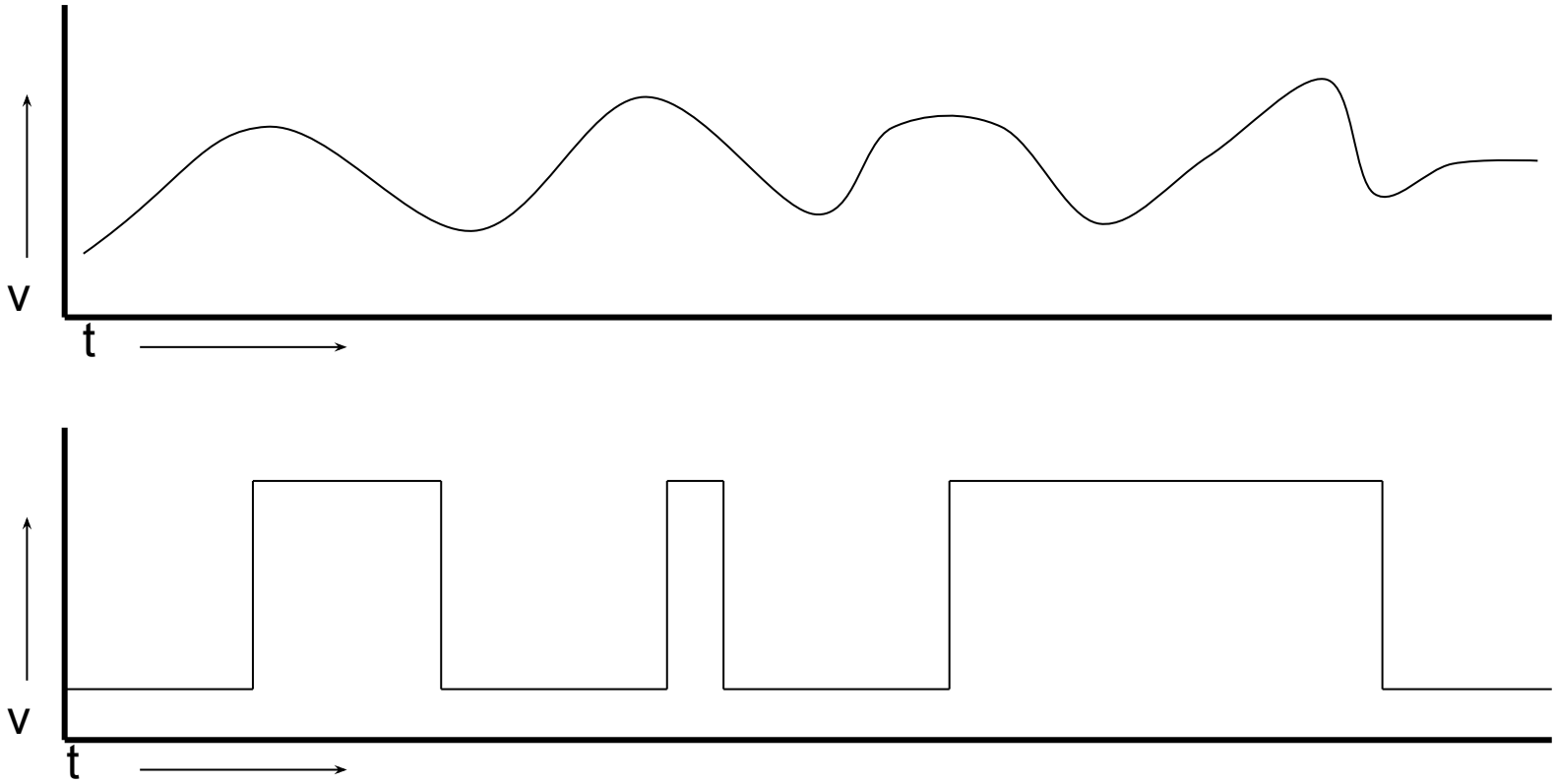


Arduino input

- Analog vs Digital input?

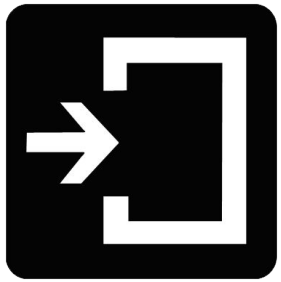
Arduino input

- Analog vs Digital input?



Digital input

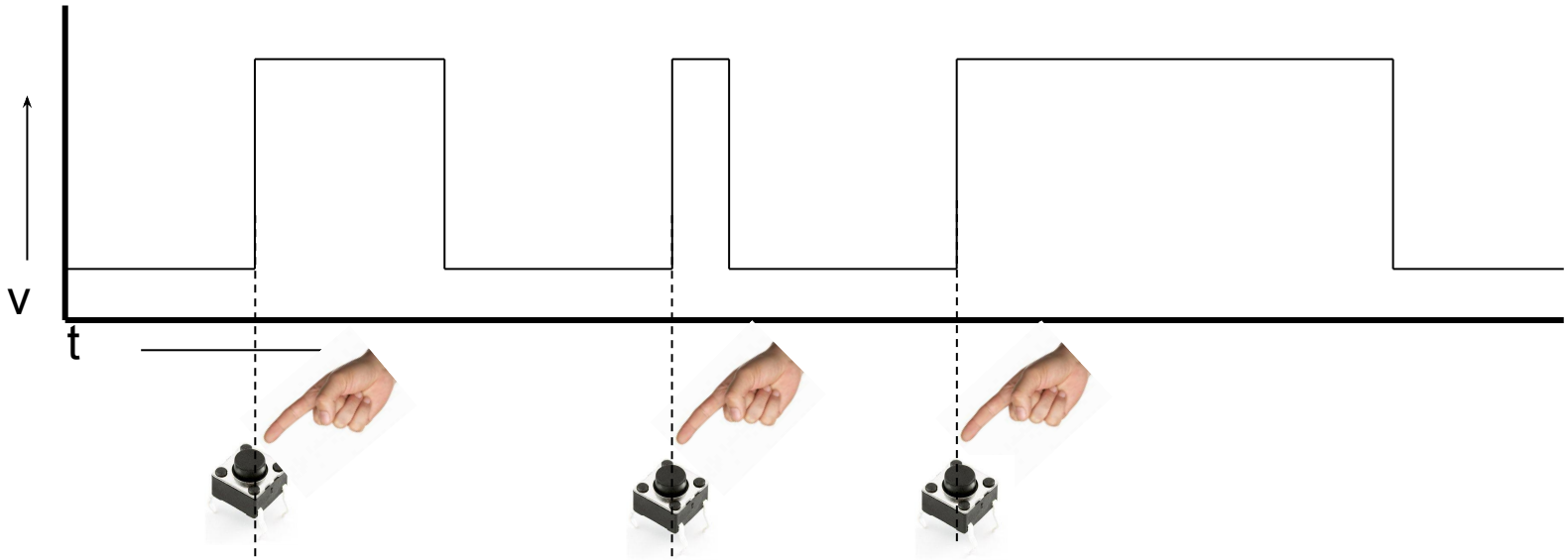
- Digital input
  - Pin 0 t/m Pin 13
  - `pinMode(<pinNr>, INPUT)`
  - `int value = digitalRead(<pinNr>)`
    - `Value == HIGH; // (= +5v)`
    - `Value == LOW;  // (= 0v (=GND))`



Digital in: Toepassingen

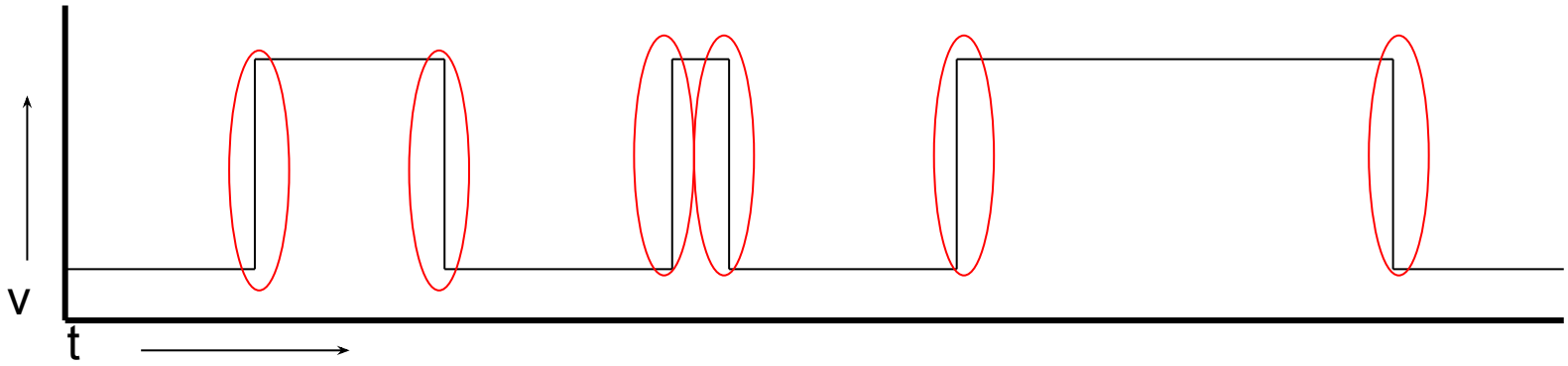
- Switch
- IR switch
- Rotary encoder
- Movement sensor

Switch: Informatie



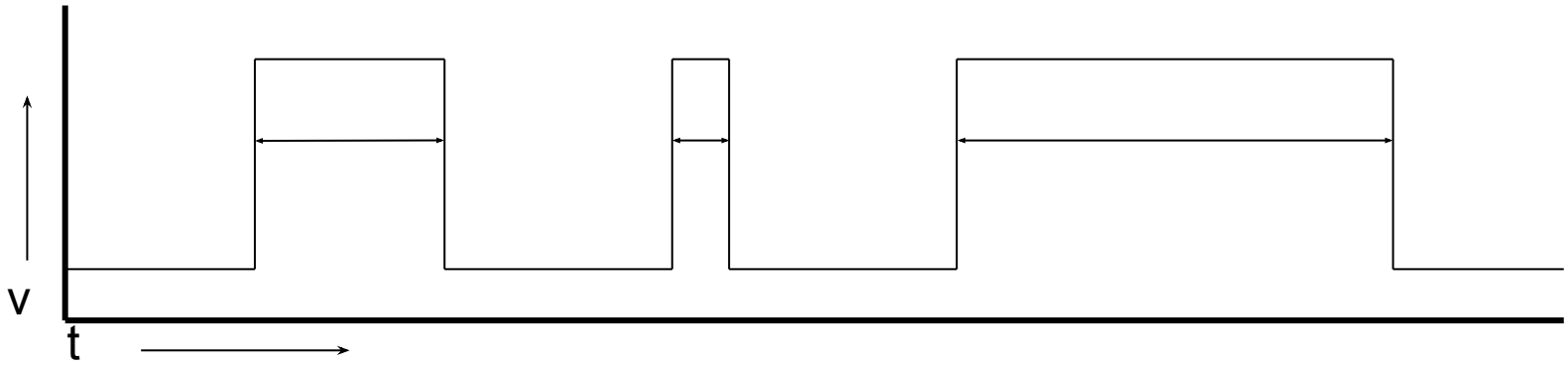
- On/ off

Switch: Informatie



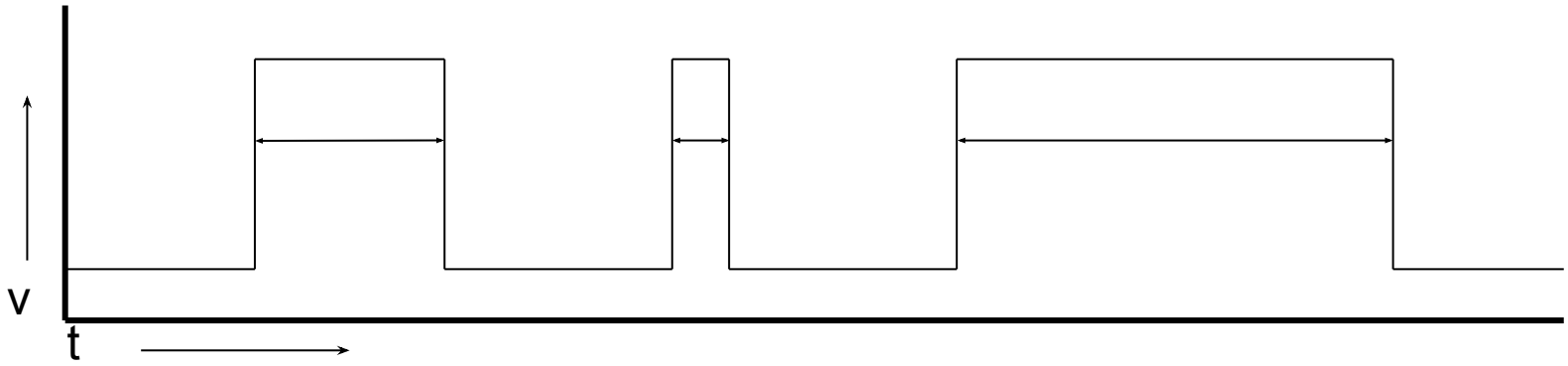
- On/Off
- From on to off, from off to on

Switch: Informatie



- On/Off
- From on to off, from off to on
- Duration

Switch: Informatie



- On/Off
- From on to off, from off to on
- Duration
- Frequency

SWITCHES







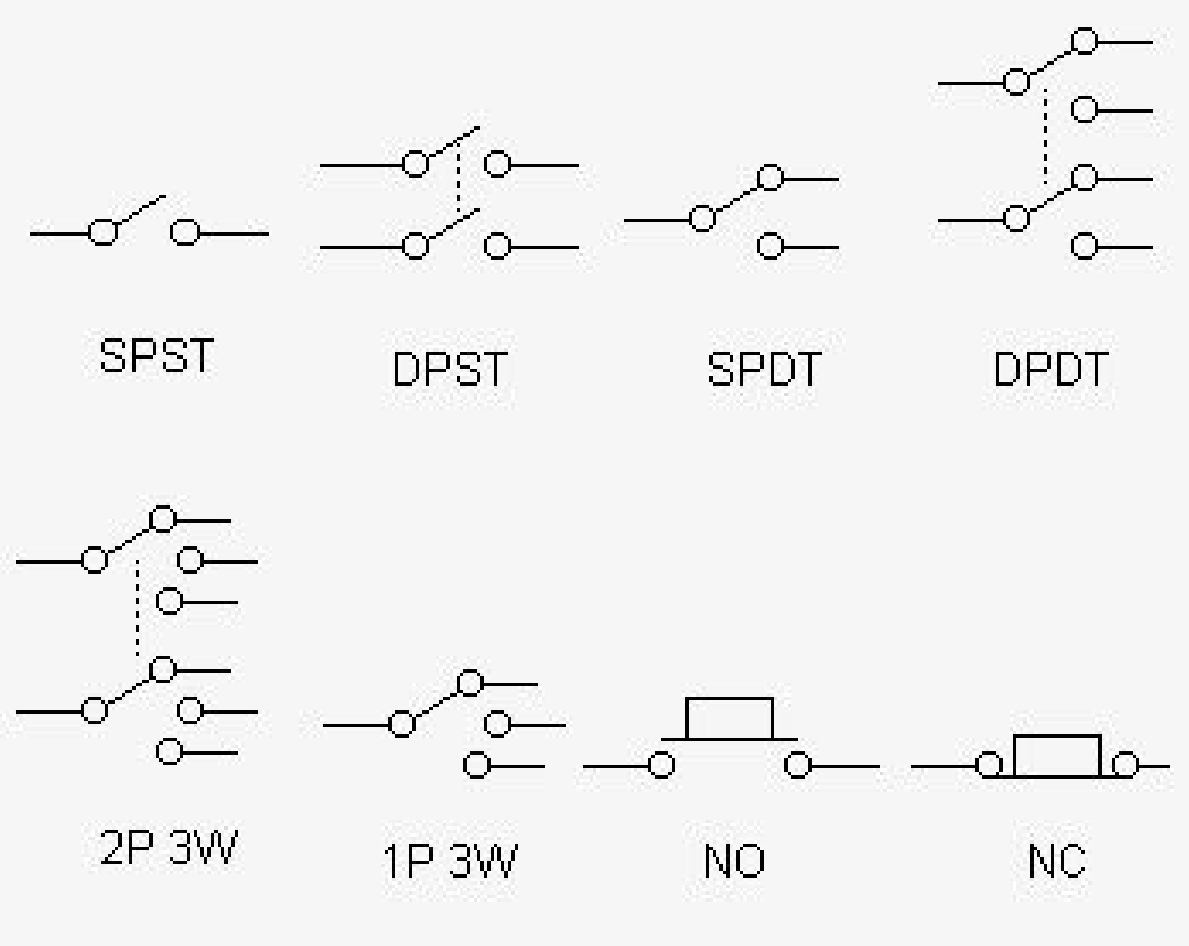



Switches: types

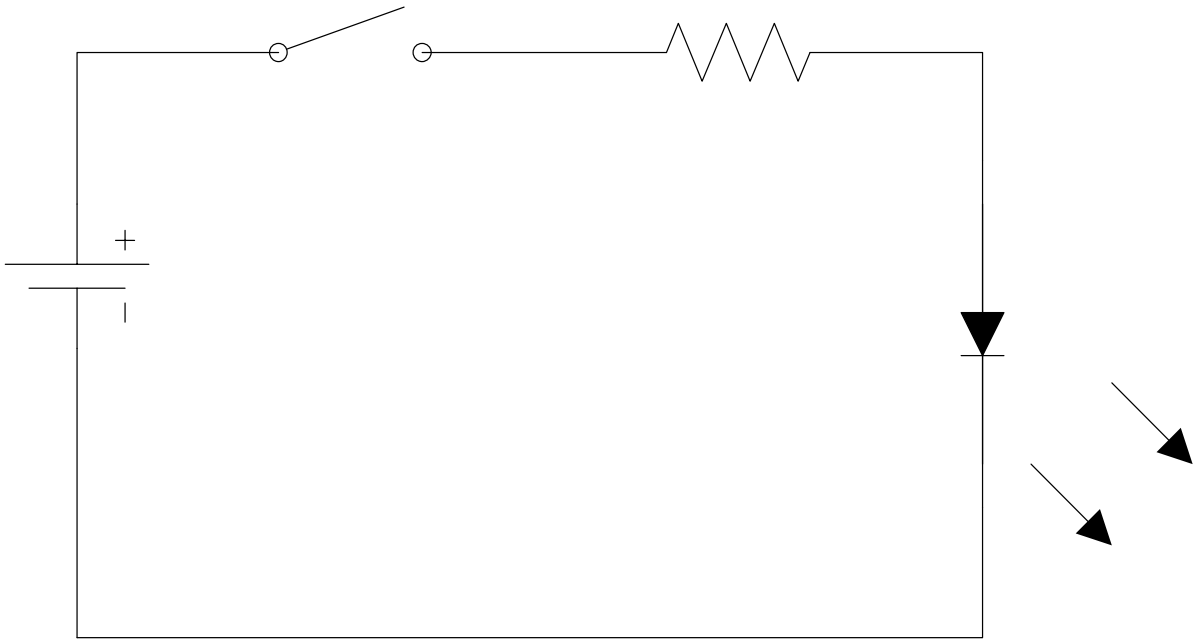
- Toggle switches

- Momentary Switches
  - Properties
    - Normally Open (NO)
    - Normally Closed (NC)

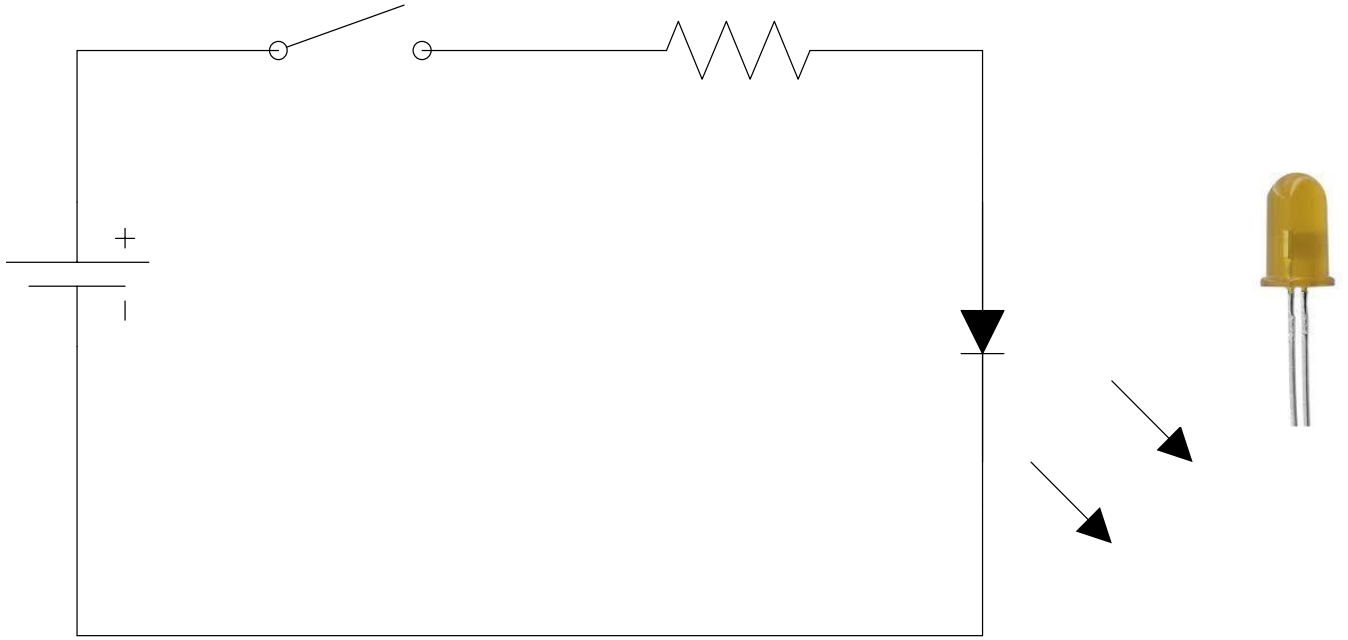
SWITCHES: TYPES



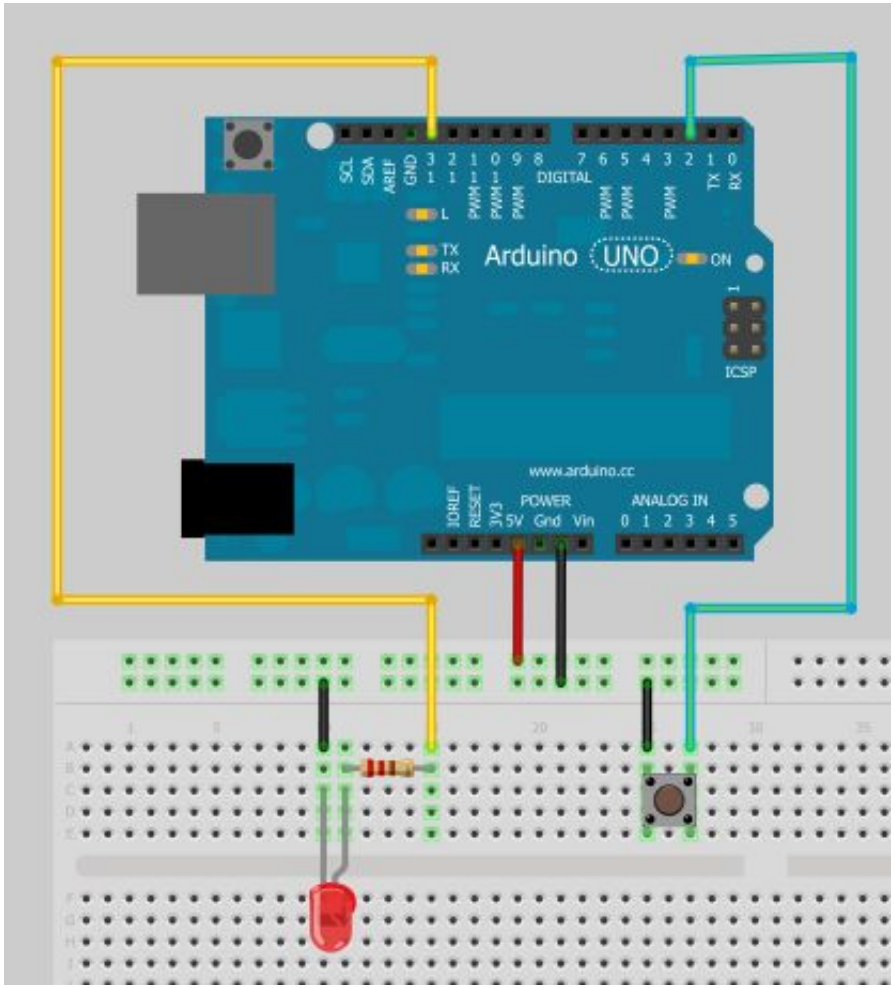
Connect switch



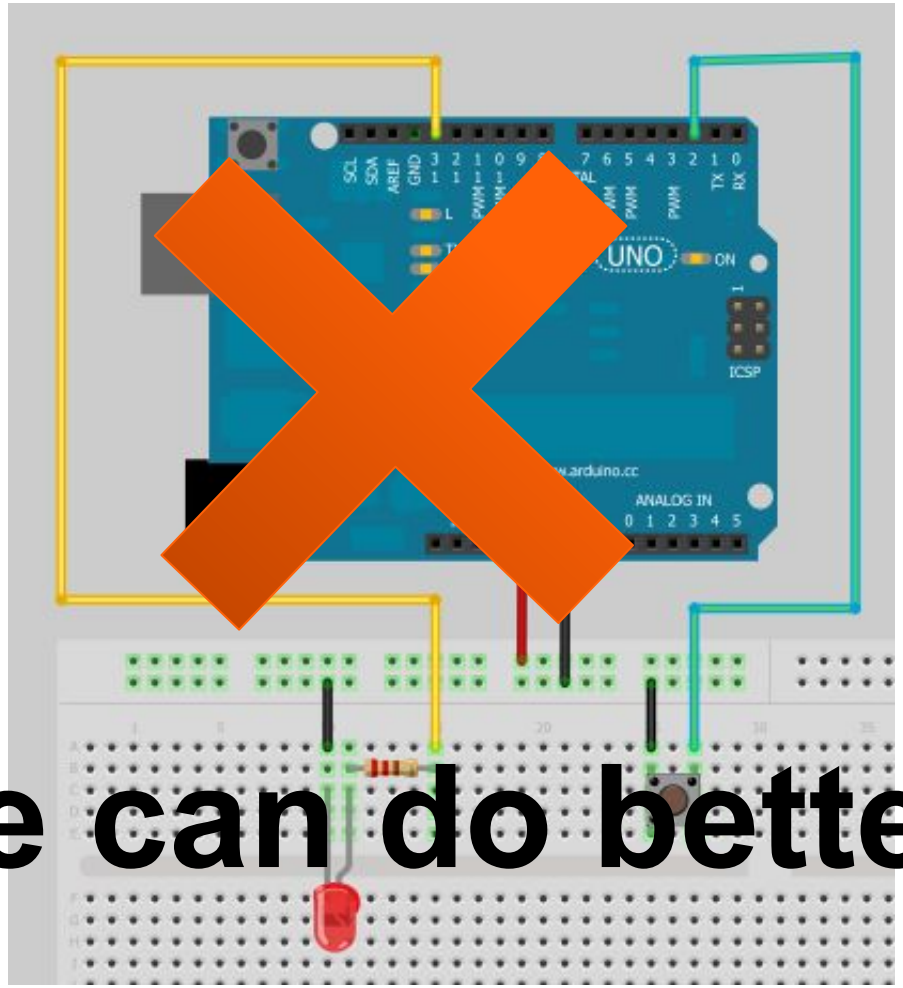
CONNECT SWITCH



CONNECT SWITCH



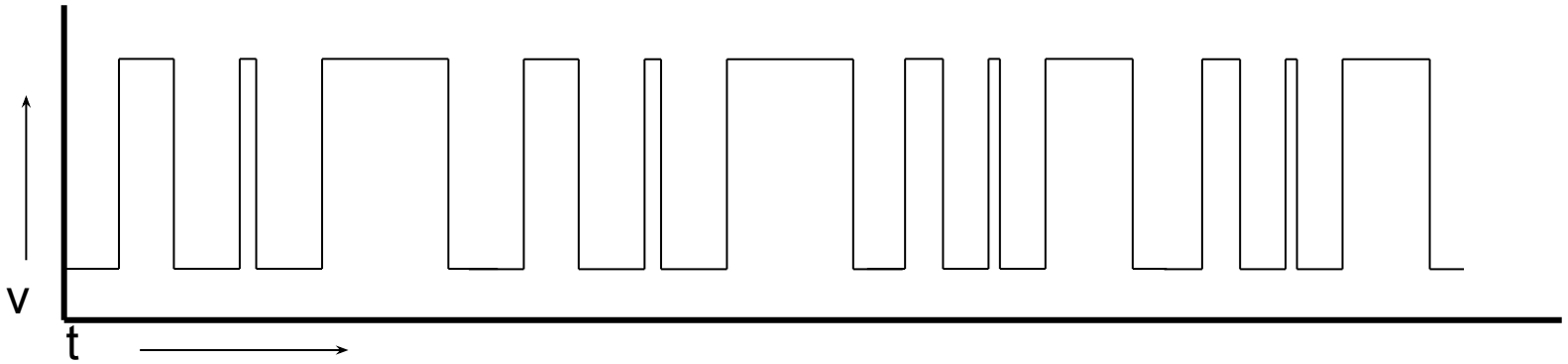
Connect switch



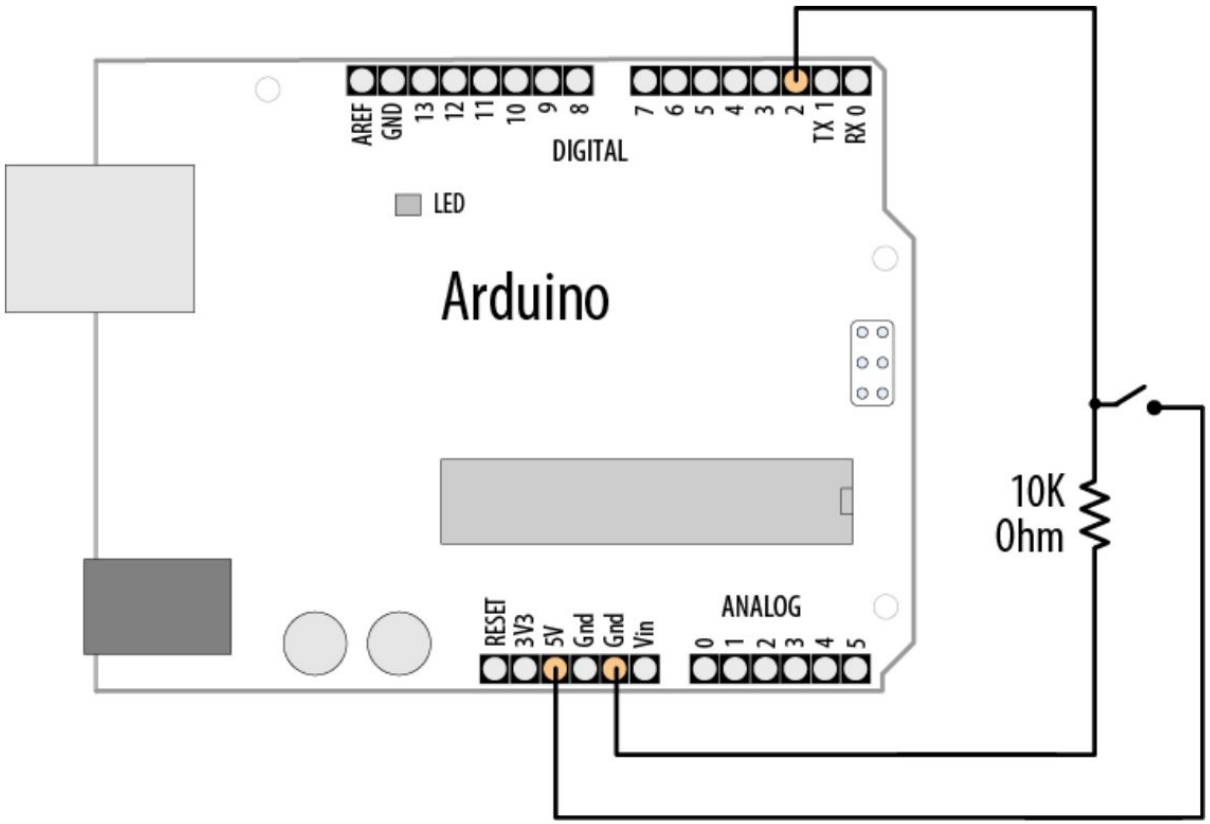
We can do better

Floating Pin

- Not connected pin is
  - not HIGH
  - not LOW
  - “random”



Pull down


AREF
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RX 0
DIGITAL
LED
Arduino
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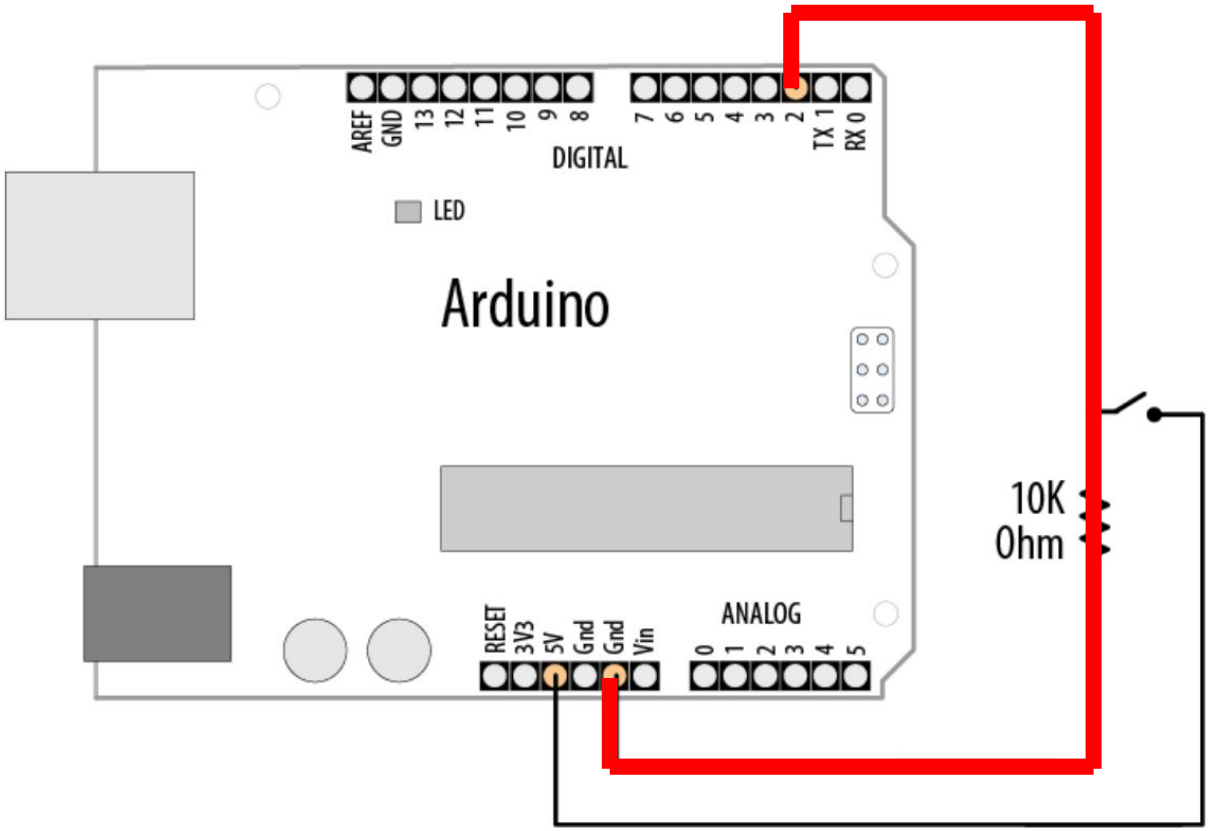
Pull down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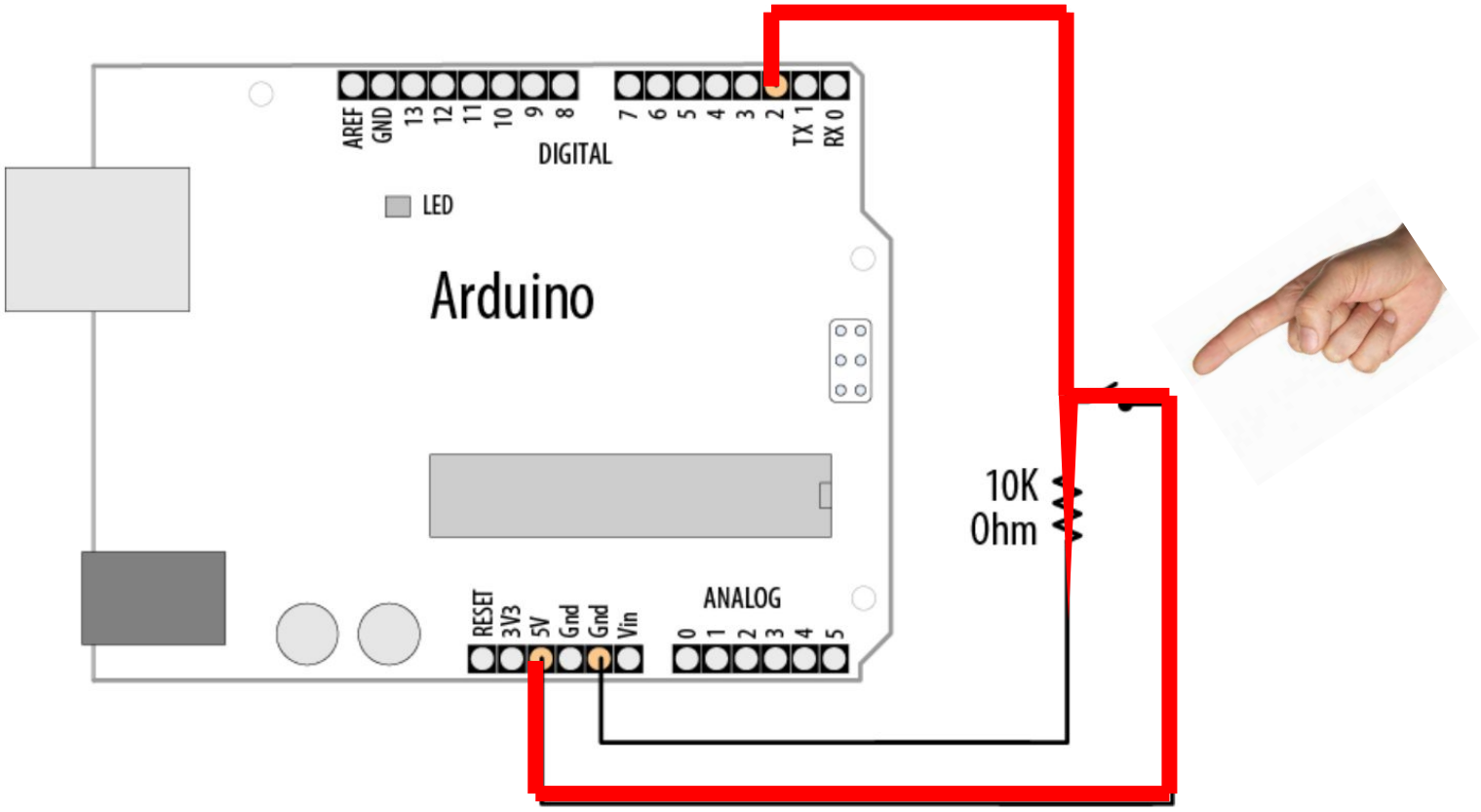
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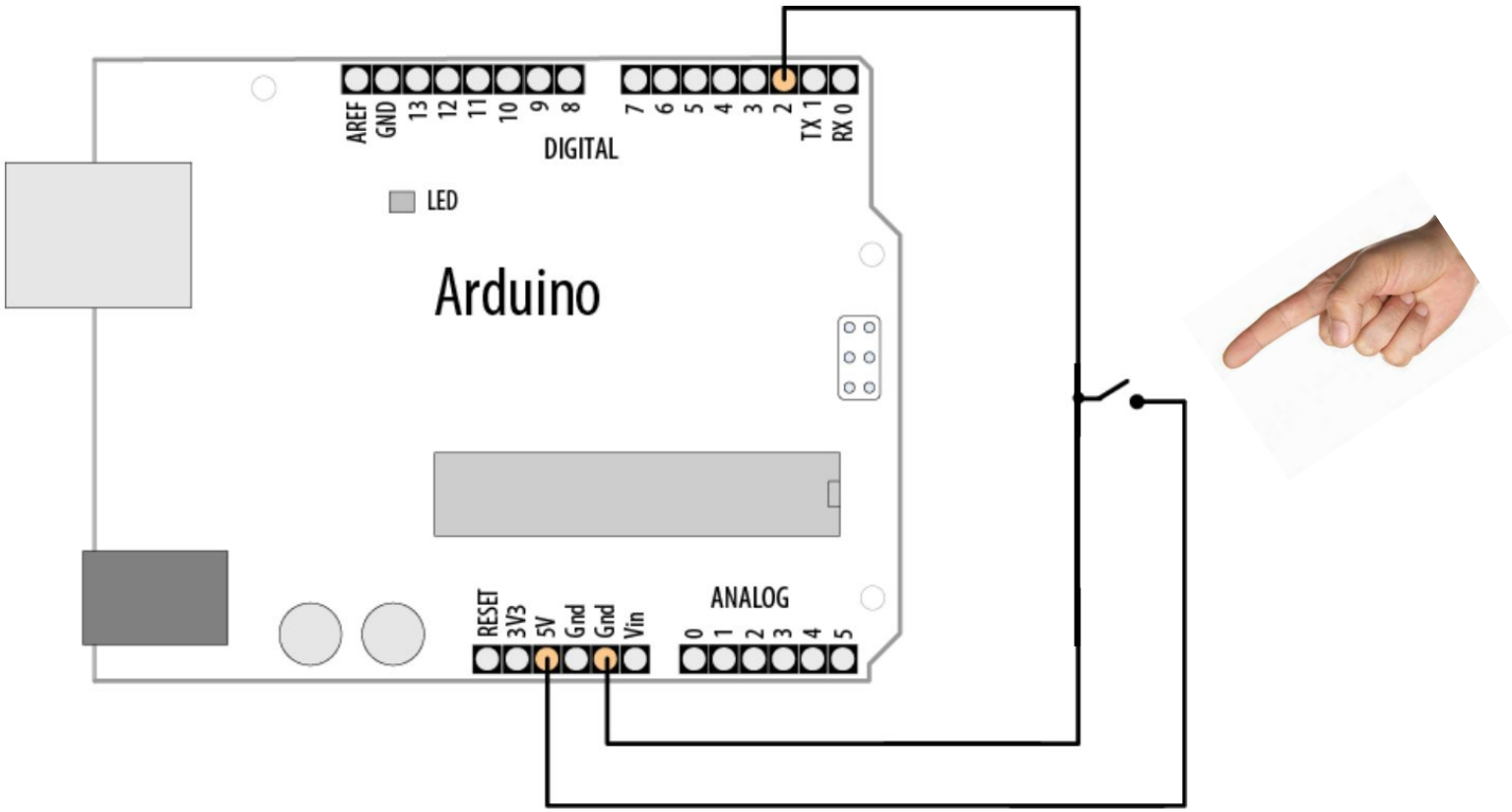
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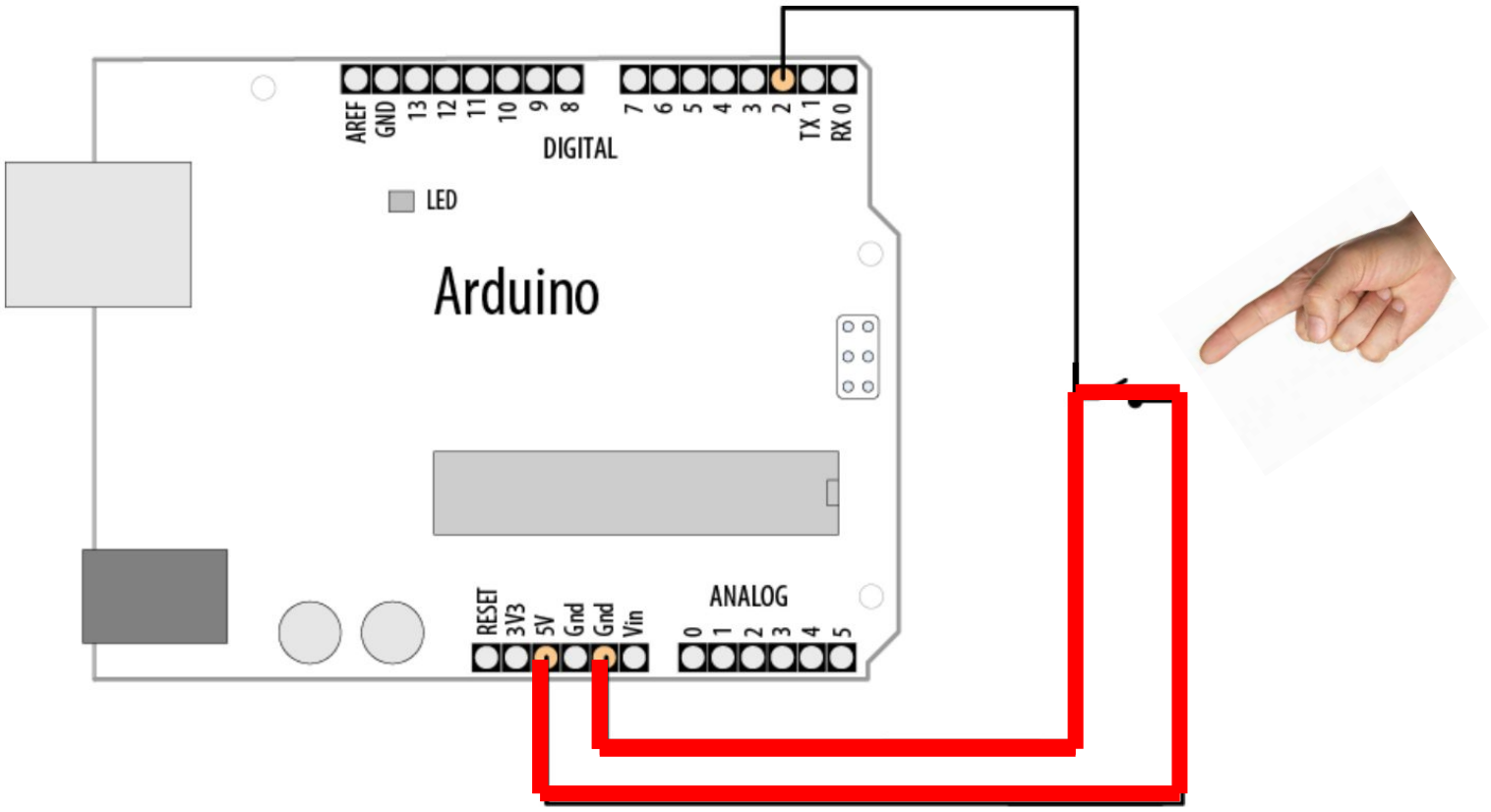
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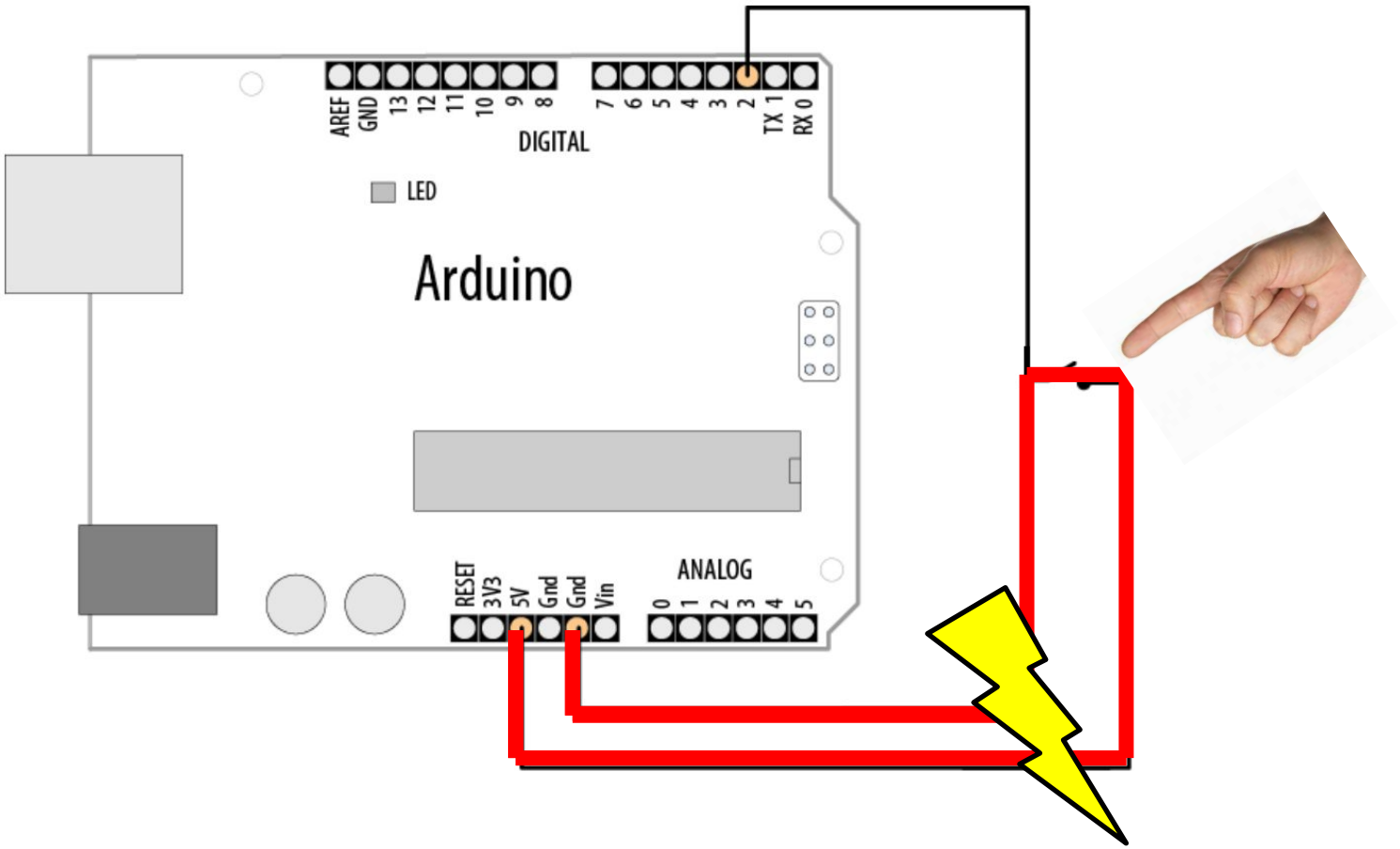
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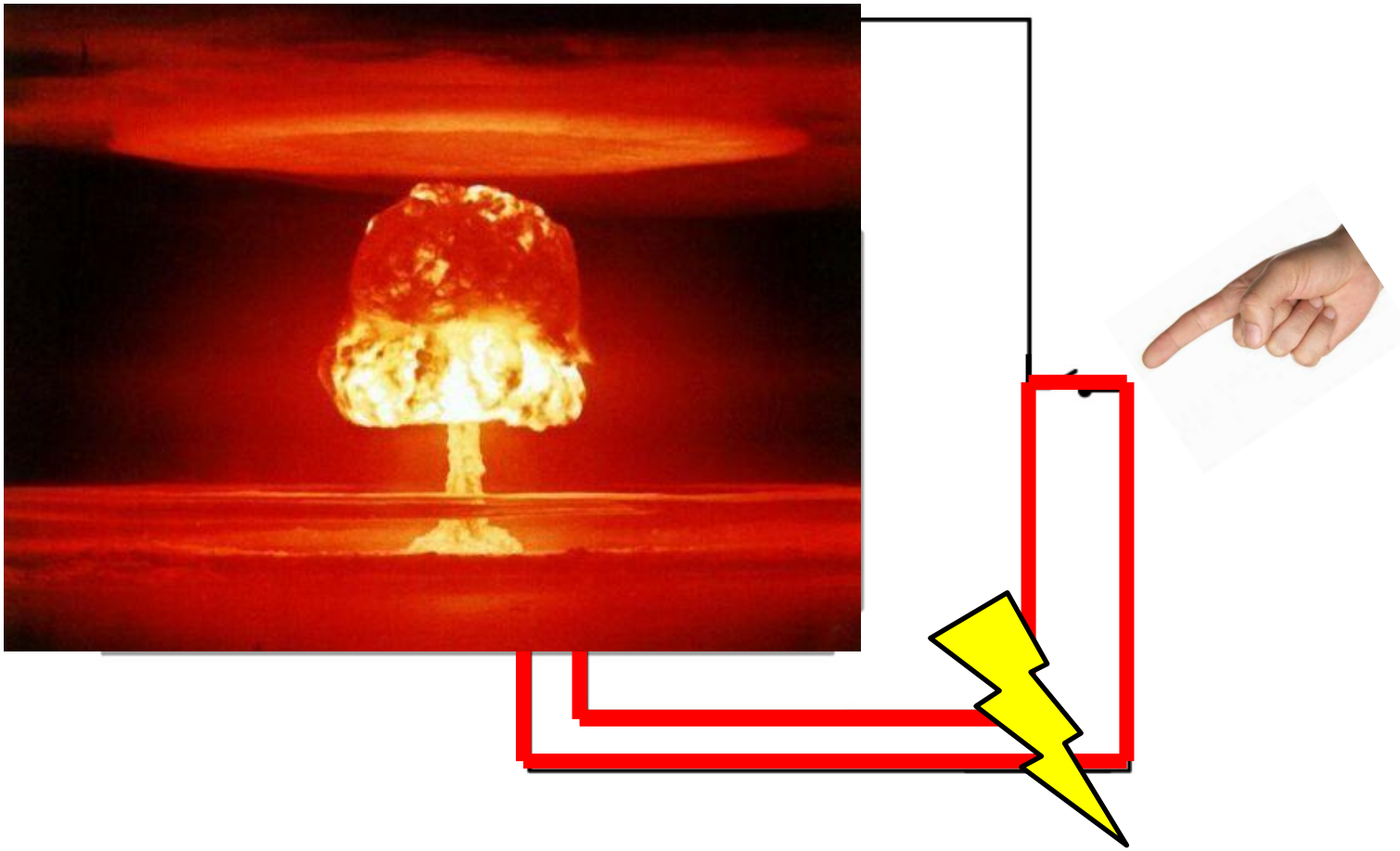

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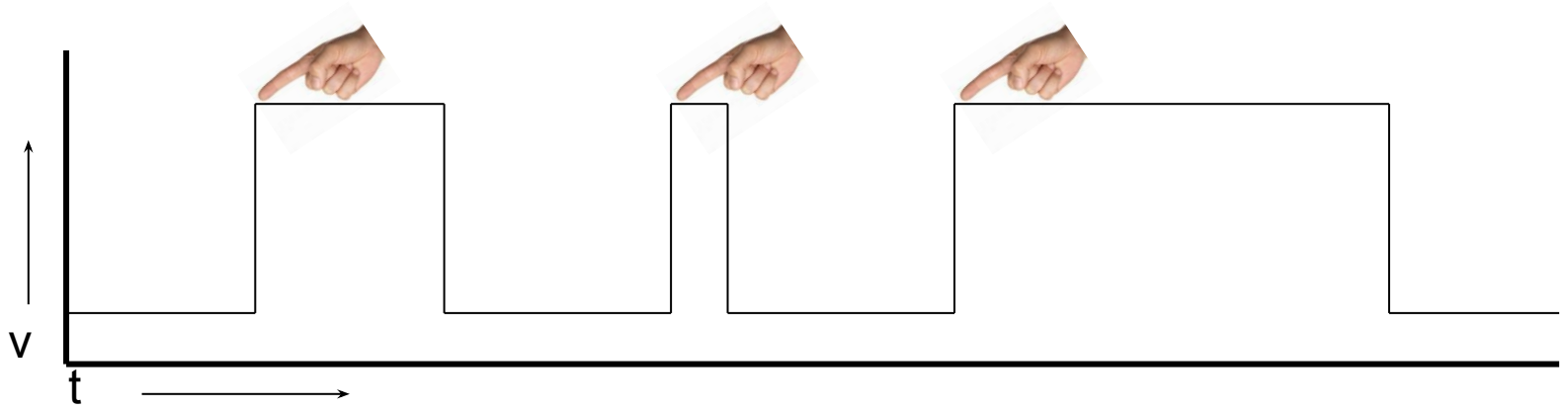
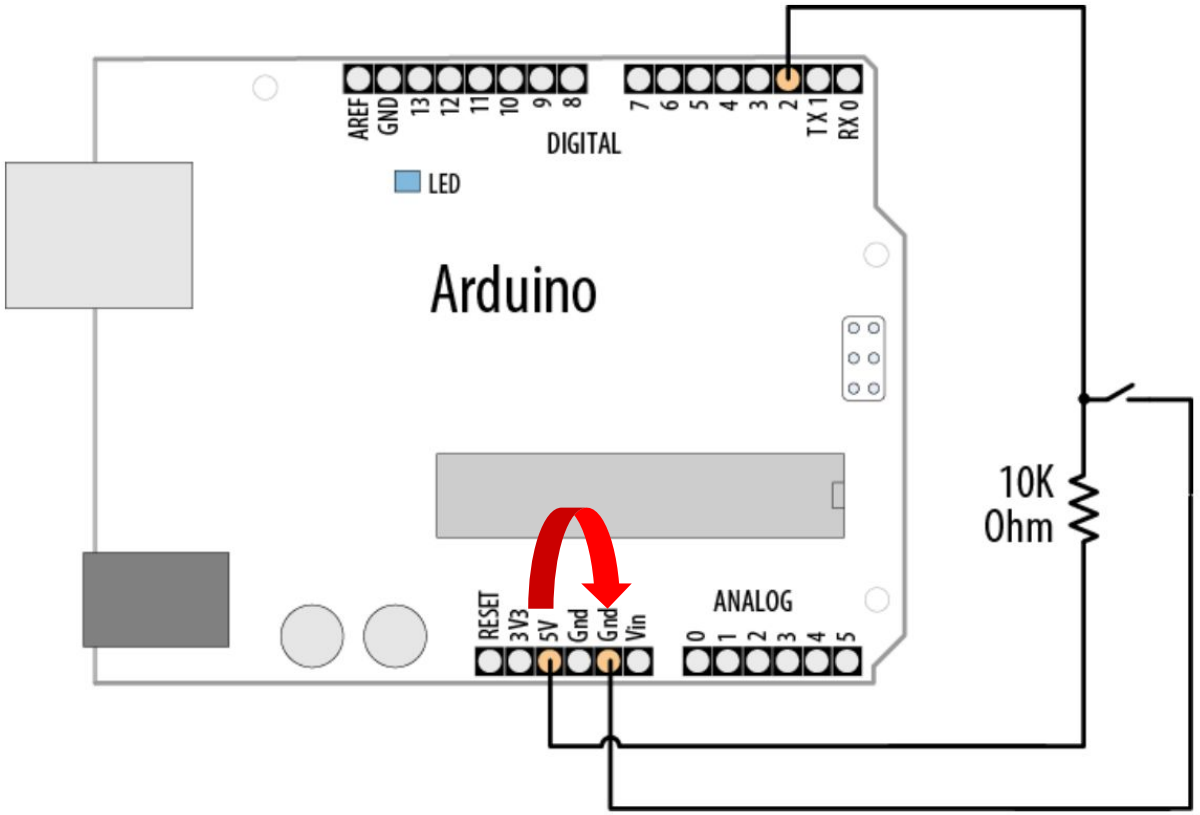


Pull Up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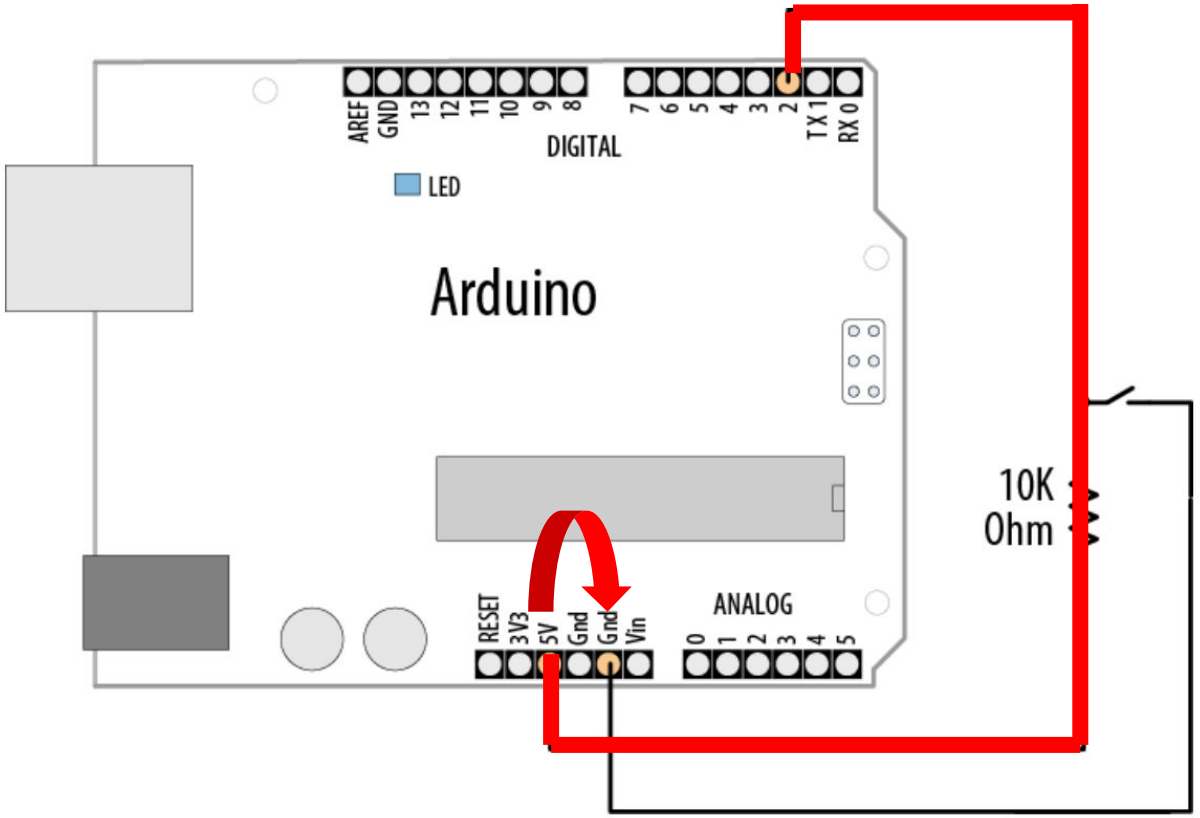
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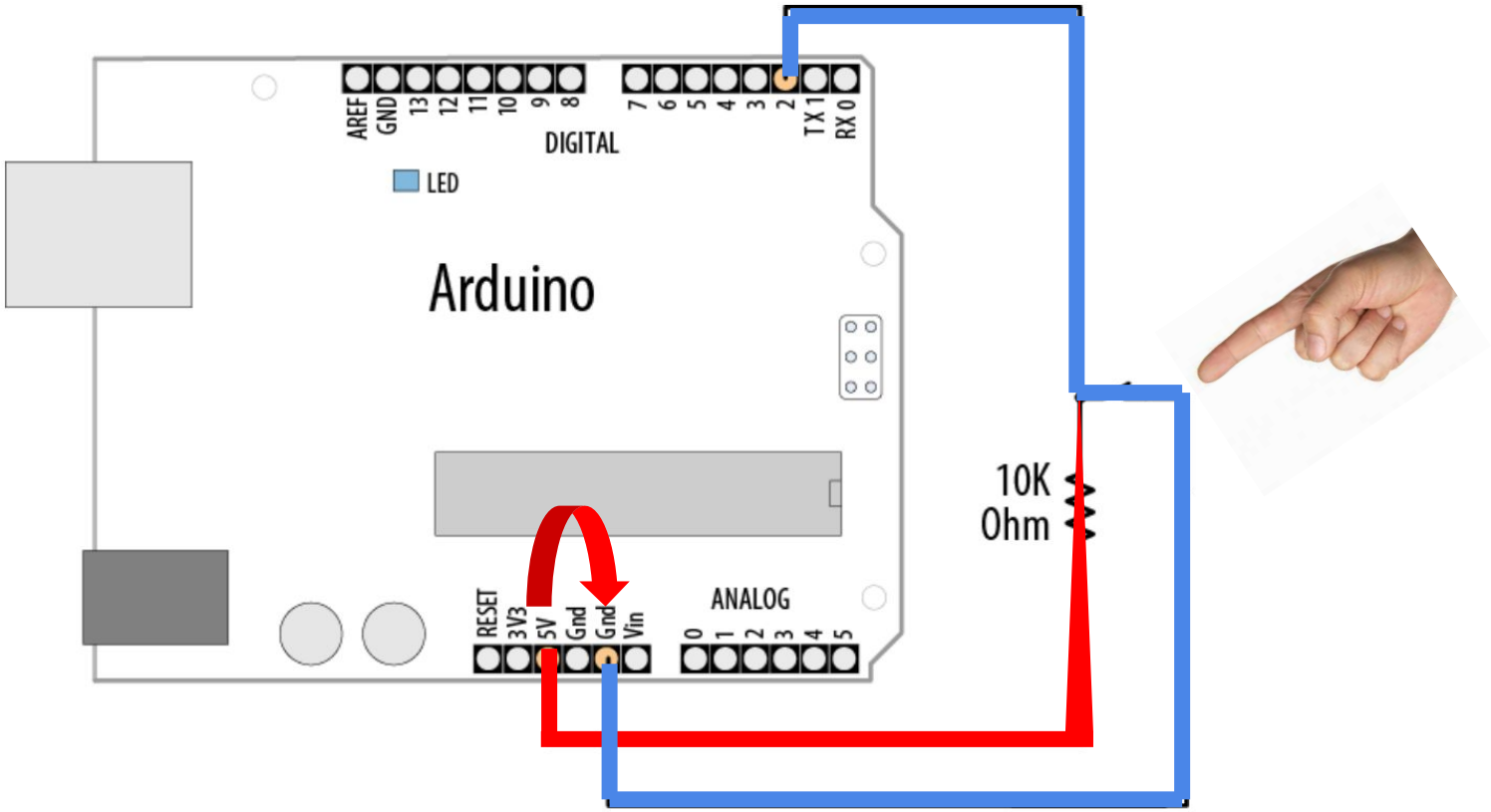
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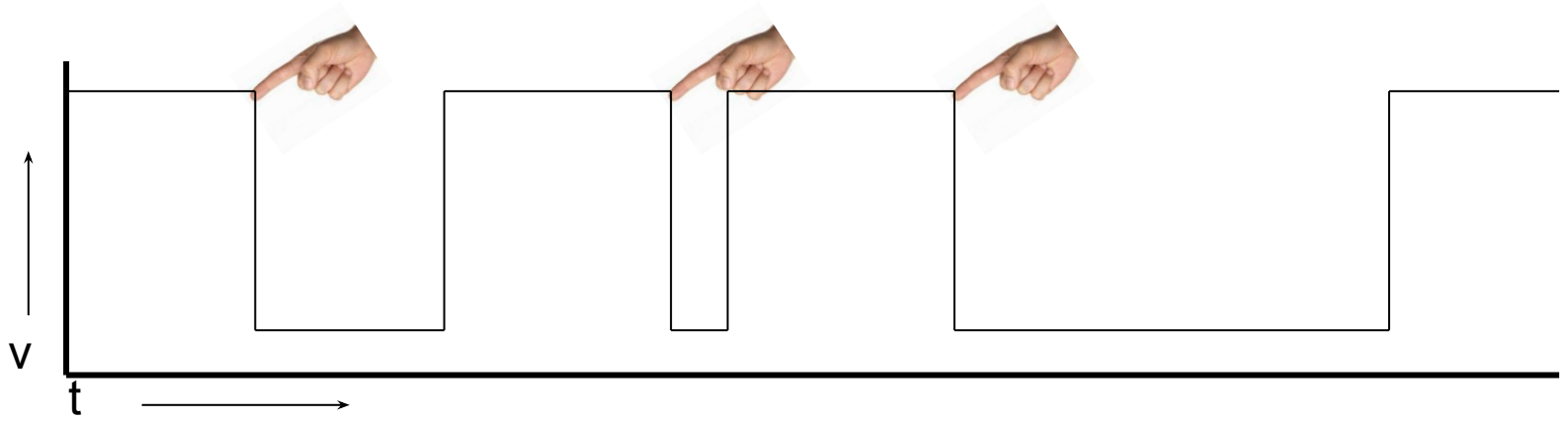


Arduino code

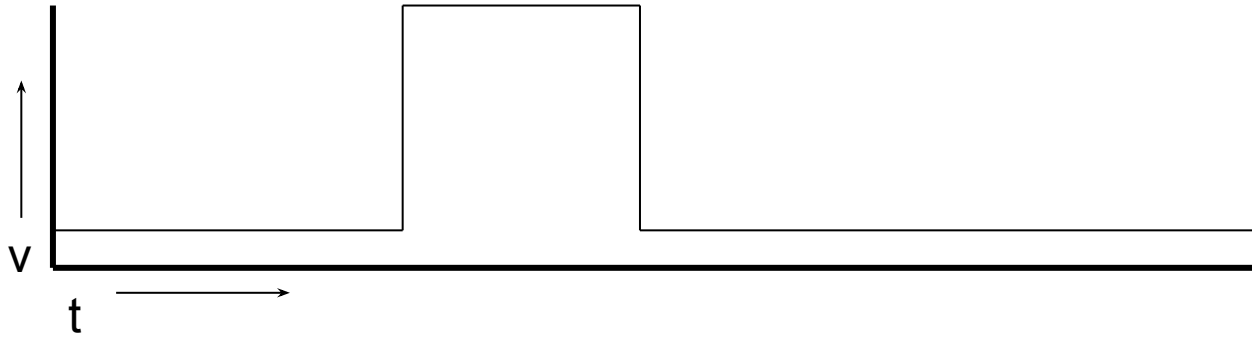
- Setup:

```
#define BUTTON_PIN 3
pinMode(BUTTON_PIN, INPUT);
```

- Loop:

```
byte value = digitalRead(BUTTON_PIN);
if (value == HIGH) {}
if (value == LOW) {}
```

Theory vs Reality



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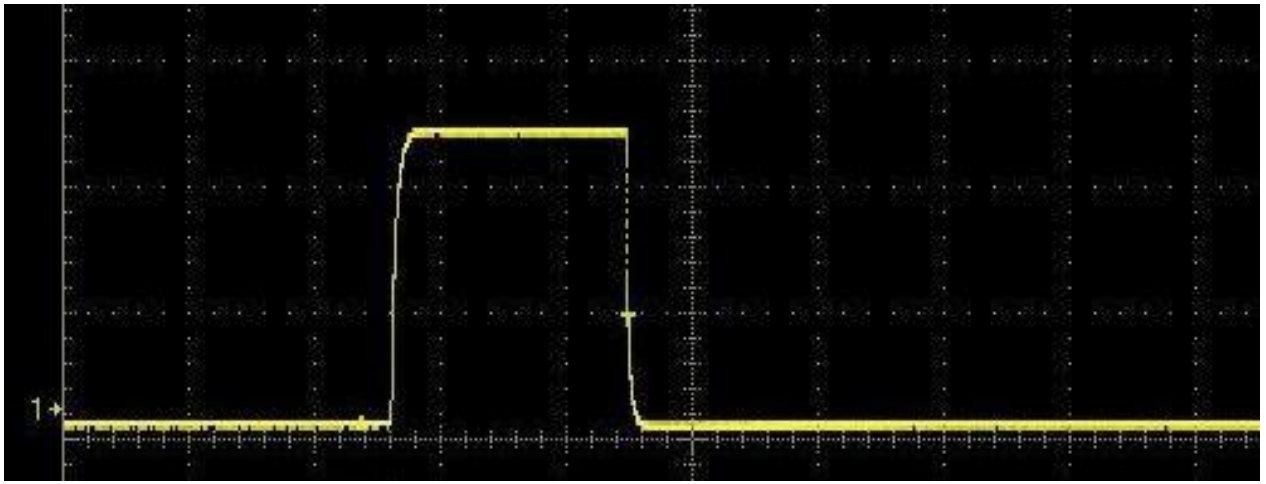
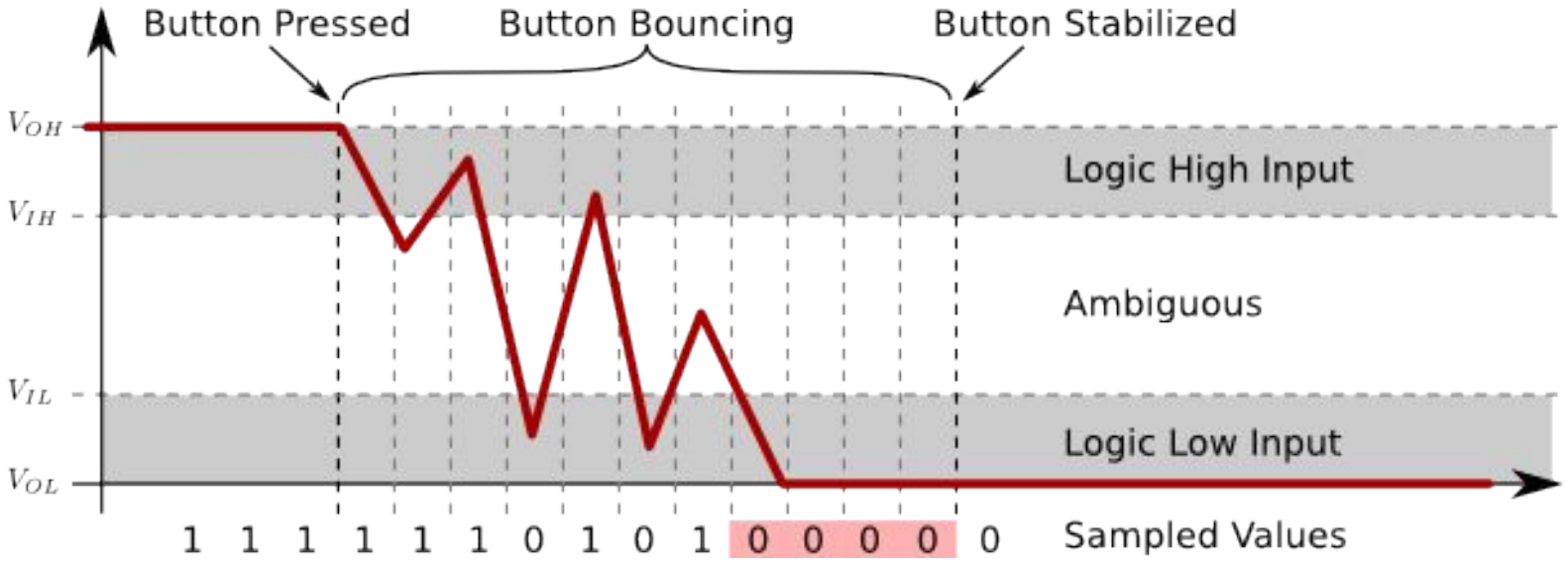


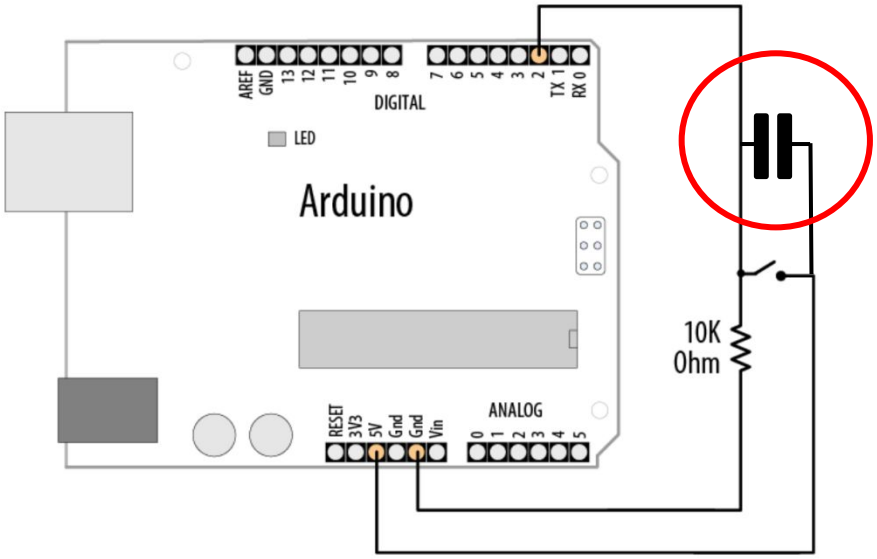
Contact bounce

- Noise at press and release

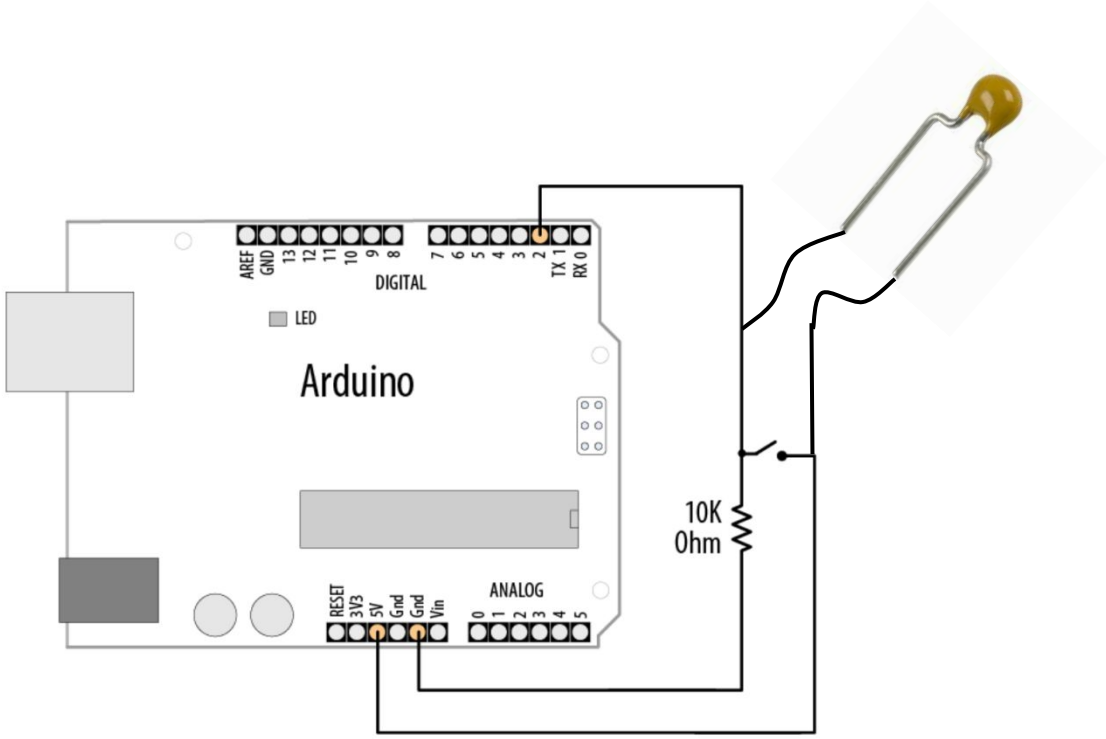


- Register multiple presses instead of 1

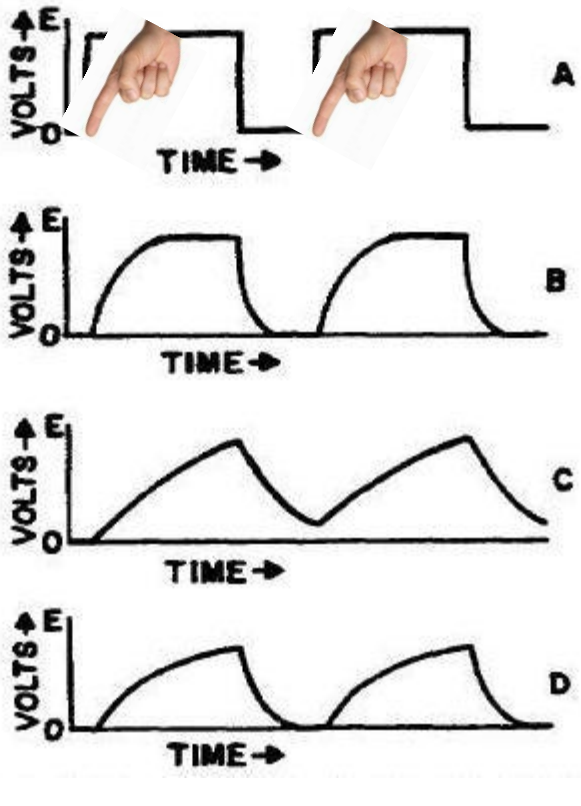
DeBounce: hardware solution



DeBounce: hardware solution



DeBounce in hardware

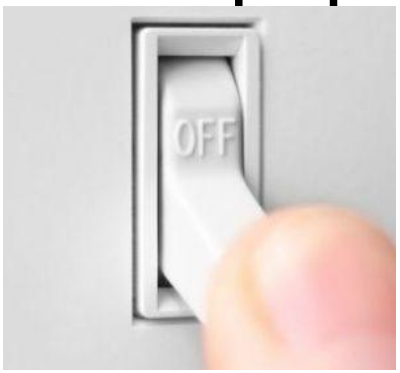


DeBounce in software?

?

Switches: Application

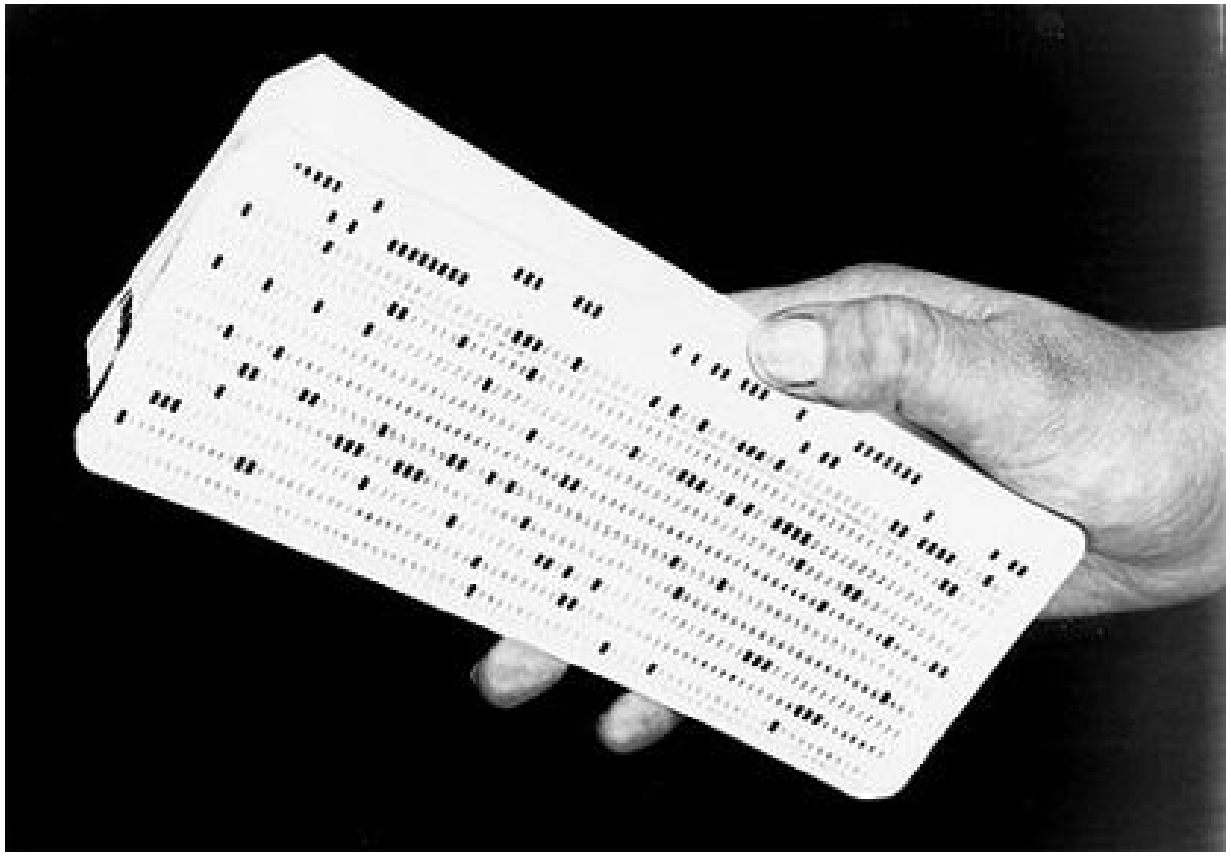
- interrupt power flow



- Register variables

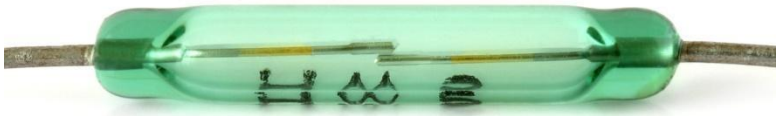
TOGGLESWITCH INPUT

PUNCHED CARD=MANY SWITCHES

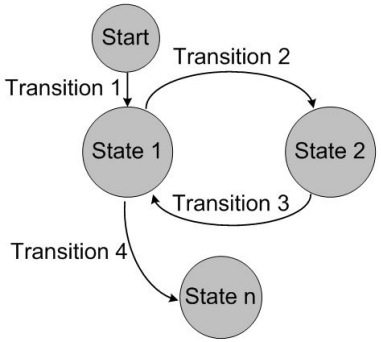


SWITCHES: APPLICATIONS

- 1 bit sensor



- State transitions



EVENTS: "MULTITASKING"

```
#define BUTTON_PIN 3
#define LED_PIN 13

void setup() {
    pinMode(BUTTON_PIN, INPUT);
    pinMode(LED_PIN, OUTPUT);
}

void loop() {
    int val = digitalRead(BUTTON_PIN);

    if (val == HIGH)
        digitalOut(LED_PIN, HIGH);
    else
        digitalOut(LED_PIN, LOW);

    delay(1000);
}
```

Interrupts

- External events
- Interrupt main program
- Function call
- Pin interrupts Arduino:

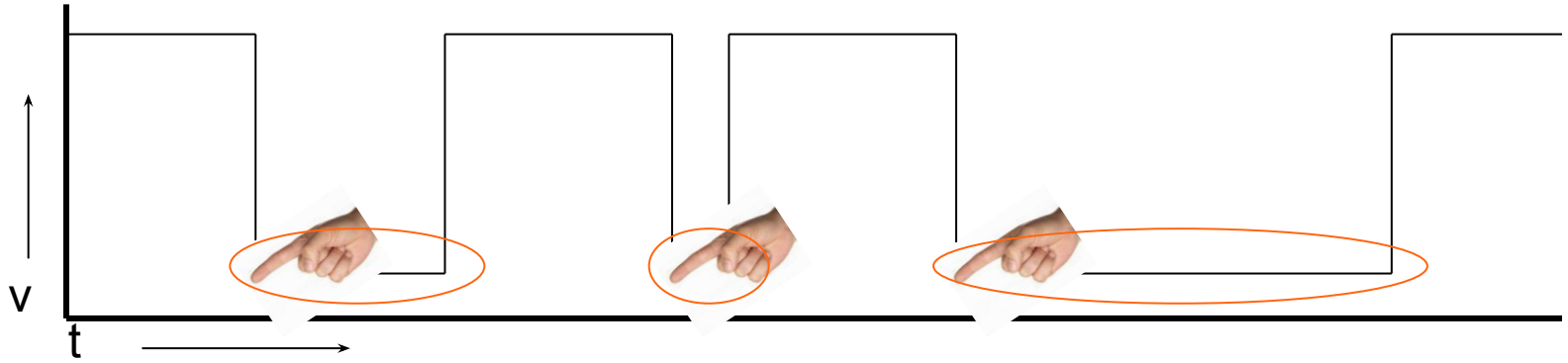
```
attachInterrupt(interrupt, function, mode)
```

Interrupts with switch

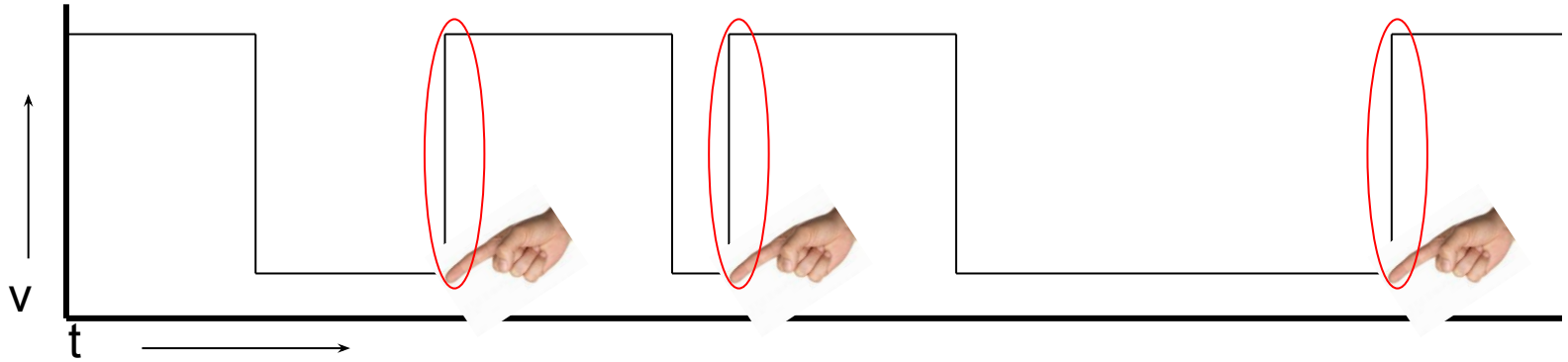
- Only digital pin 2 (interrupt 0) and 3 (interrupt 1)
- Mode:
  - LOW
  - RISING
  - CHANGE
  - FALLING

Pin Interrupt modes

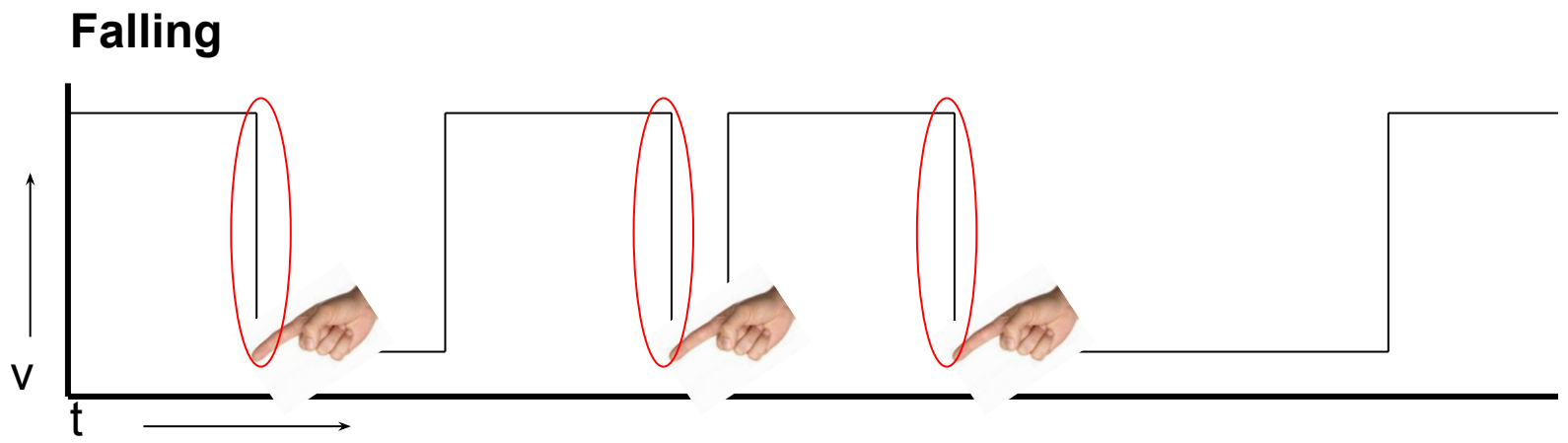
LOW

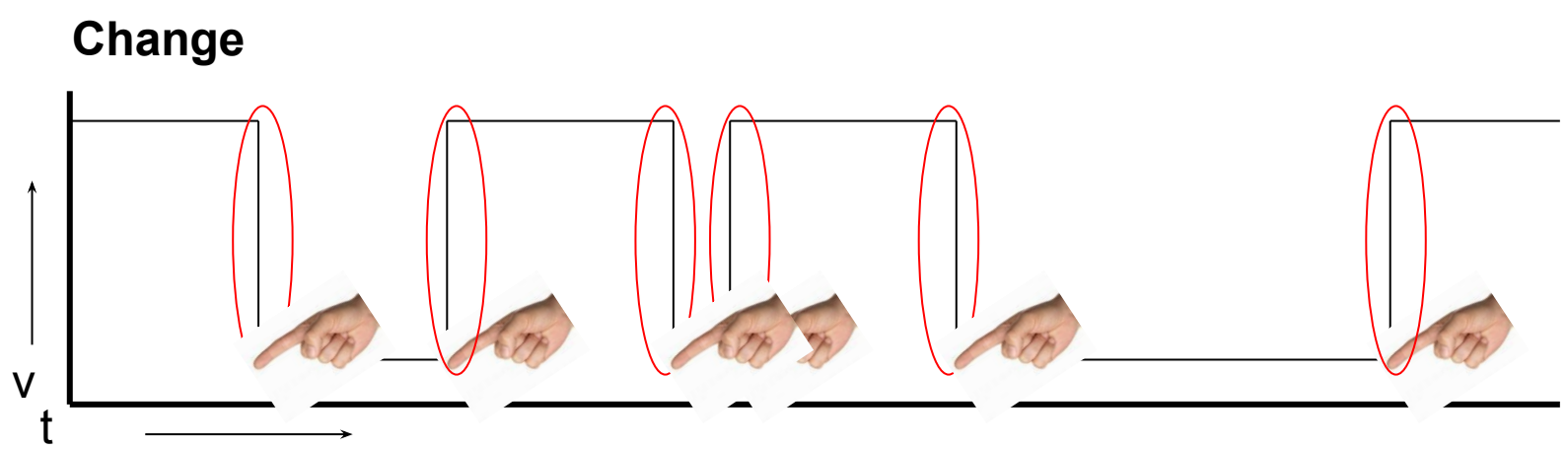


RISING



Pin Interrupt modes





Pin Interrupts: example

```
int pin = 13;
volatile int state = LOW;

void setup()
{
  pinMode(pin, OUTPUT);
  attachInterrupt(0, blink, CHANGE);
}

void loop()
{
  digitalWrite(pin, state);
}

void blink()
{
  state = !state;
}
```

Different interrupts

- Next to “pin change” interrupts also:
  - Timer interrupts
  - AD conversion
  - Watchdog
  - Serial data
  - .
  - .
  - Etc…

Timer interrupt

- Next to instruction also a counter
- Counter can call “interrupt” function
- Used for:
  - 30 images per second
  - 100 measurements per second
  - Increase counter 60x per minute

WAARSCHUWING!

- Minimize code in callback function
  - `no delay()`
  - `no millis()`
  - serial communication doesn't work (properly)
  - maybe previous interrupt not finished
- global variables in interrupt are:"`volatile`"