
HSHL HACKATHON 2025
HOCHSCHULE
HAMM-LIPPSTADT

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Time table

- **19.03.2025 Wednesday 12:00-19:00 -**
- First day of the event
- Getting to know the hardware
- **20.03.2025 Thursday 10:30-19:00 -**
- Starting with the tasks
- **21.03.2025 Friday 10:30-17:00 -**
- Finishing the tasks
- 17:00-18:00
- Counting of the points.
- Announcement of the winner team.

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THE BOX

- Each team is given one **BOX** of components listed further and on **THE BOX** itself
- The Hackathon competition is comprised of **5 Tasks**
- You have enough parts in **THE BOX** to complete any task, but not every task at the same time.
- **Plan accordingly.**

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THE BOX parts

THE BOX contains parts, for which you are responsible as a team:

- Arduino Uno Microcontroller x2
- Breadboard x1
- Numpad x1
- Servo motor 9g x3
- Servo Motor 360° x1
- Button x2
- Photoresistor x3
- USB Wire For Arduino x2
- RGB Diode x1
- Piezo Speaker x1
- IR sensor x3
- Display x1
- Variable resistor x3
- Radio Module x2

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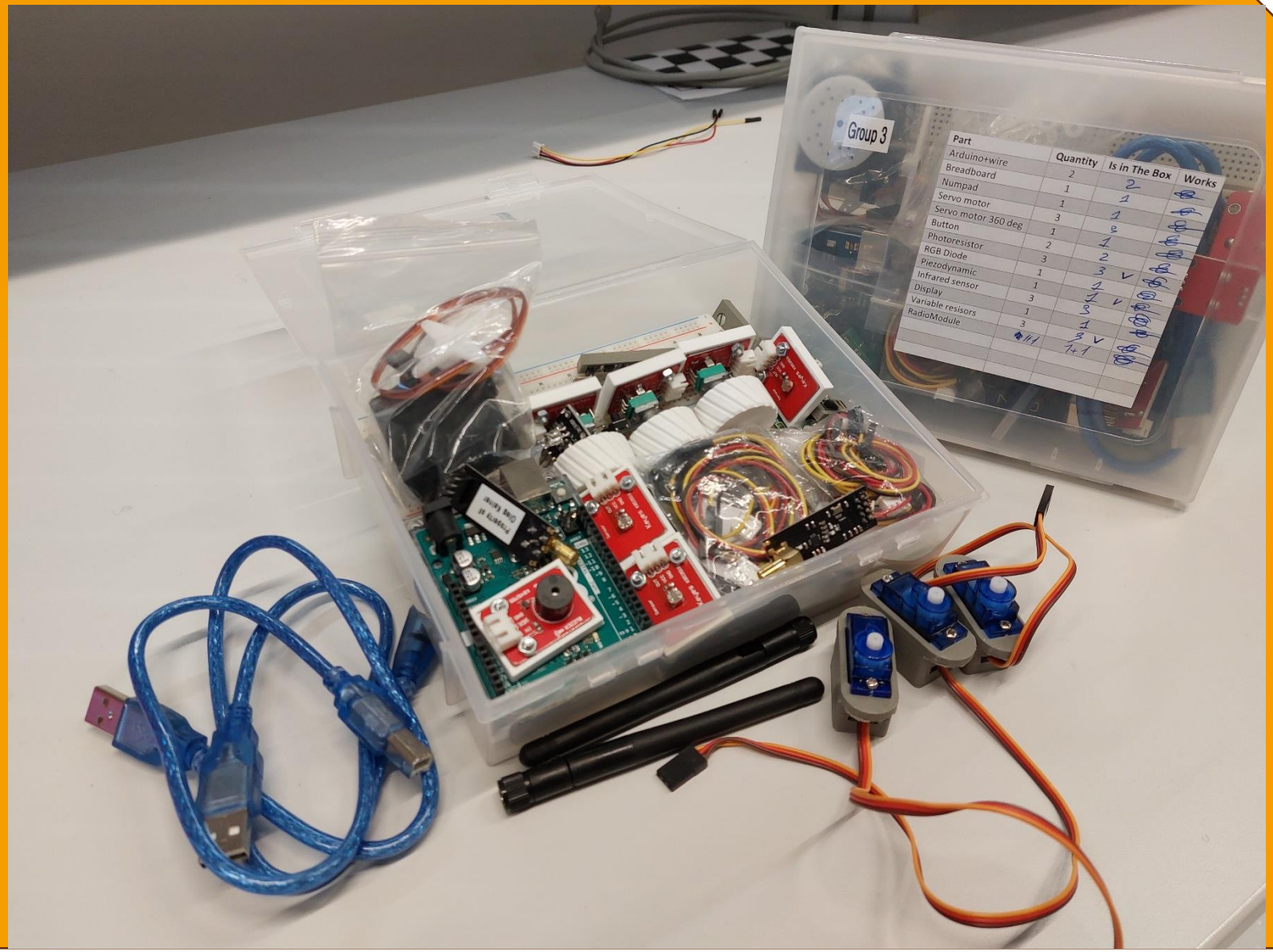
THE BOX
parts



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Regarding the Tools and THE BOX

Your team is responsible for the equipment you have.
At the end of competition, we expect to get the box and the tools as they were given out.

- Egregious material hogging
- malicious destruction of parts, tools and materials
- negligent destruction of parts, tools and materials
- repeated destruction of parts, tools and materials

May result in

- stern talking's to,
- points deduction,
- long and uncomfortable gazes,
- walks of shame,
- expulsions,
- heavy fines,
- etc.

Jokes aside, just **be careful and immediately speak to one of the organisers if something is** bended, broken, glued shut, fuming or generally **not performing like you would expect it to.**

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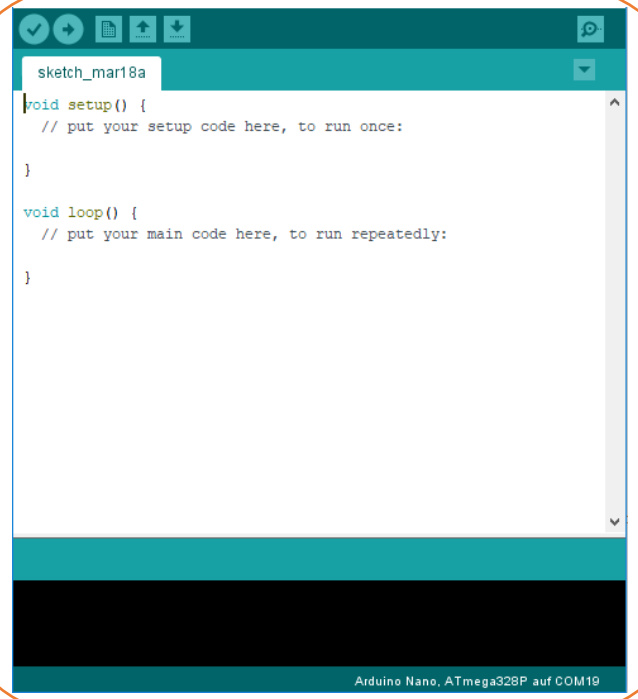
Arduino Uno



- You know it
- You love it
- Open Arduino IDE
- Put what you need for setup in setup
- Put what you need in a loop in a loop
- Connect sensors or motors to the various pins
- Connect your Arduino with a usb
- Choose the right port and press Load
  → And it will just do it!

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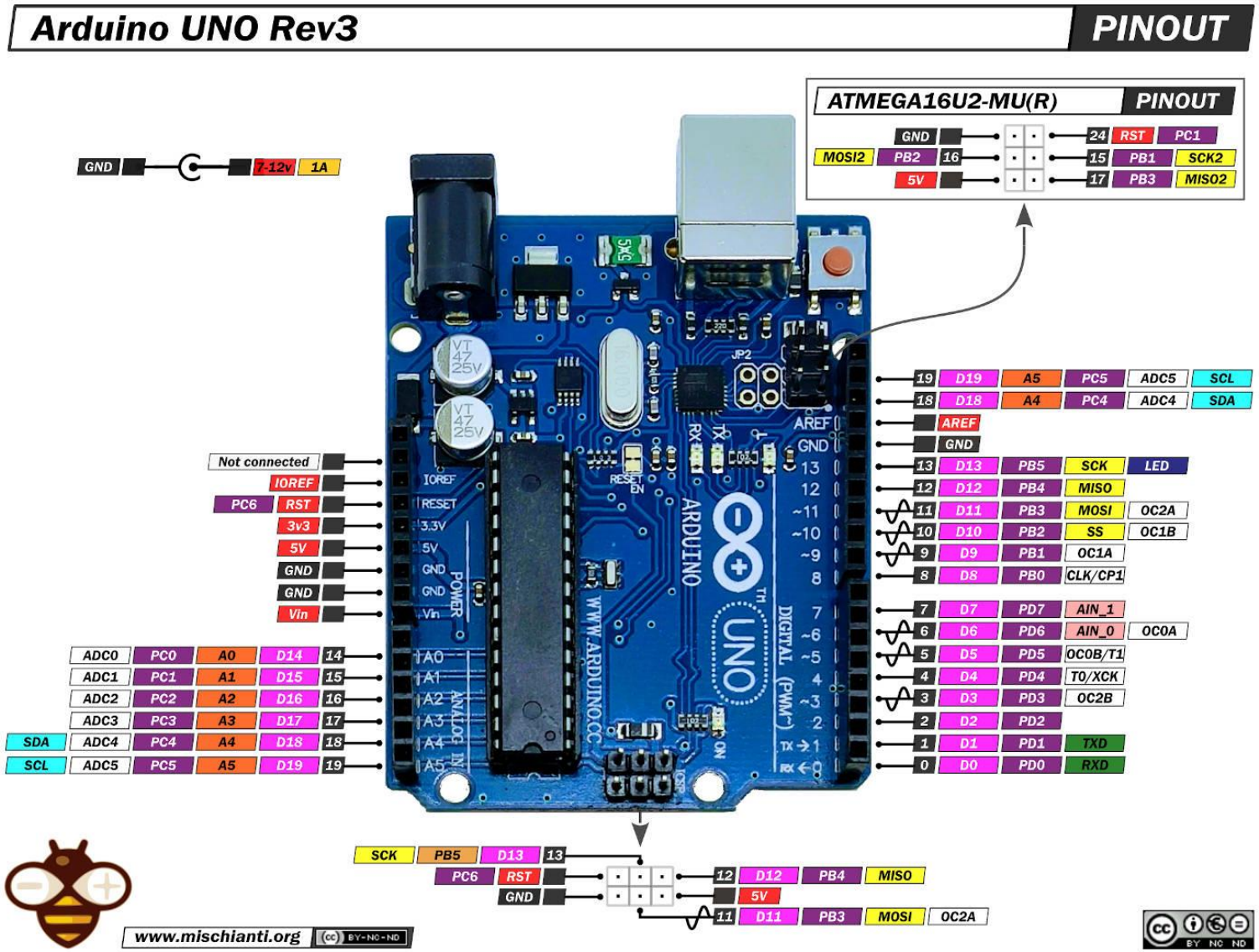
Arduino Uno



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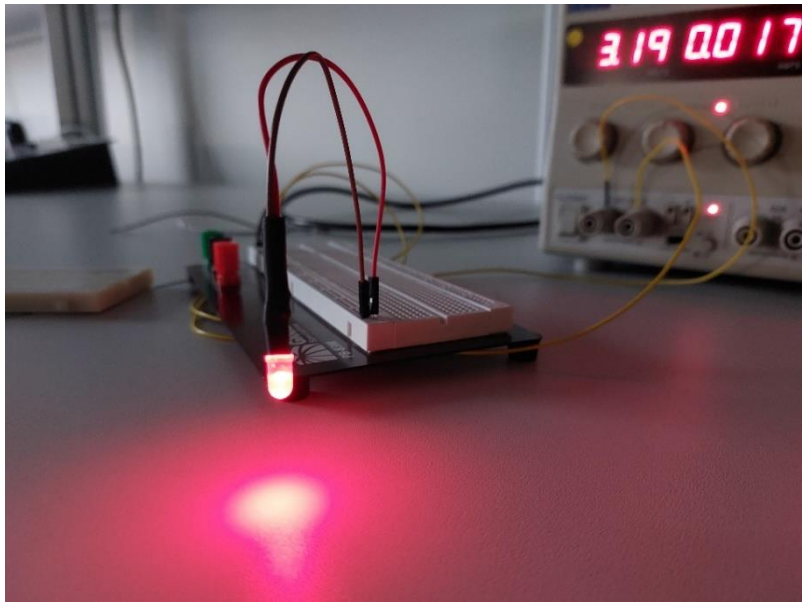
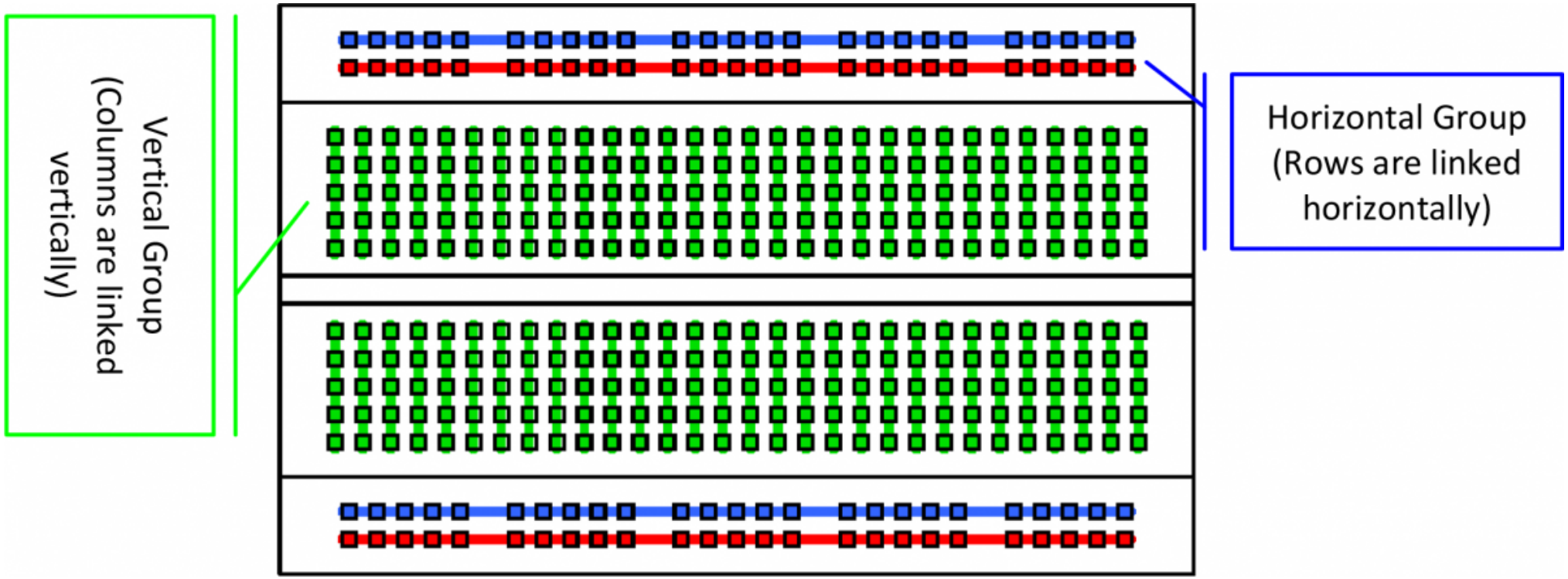
Breadboard





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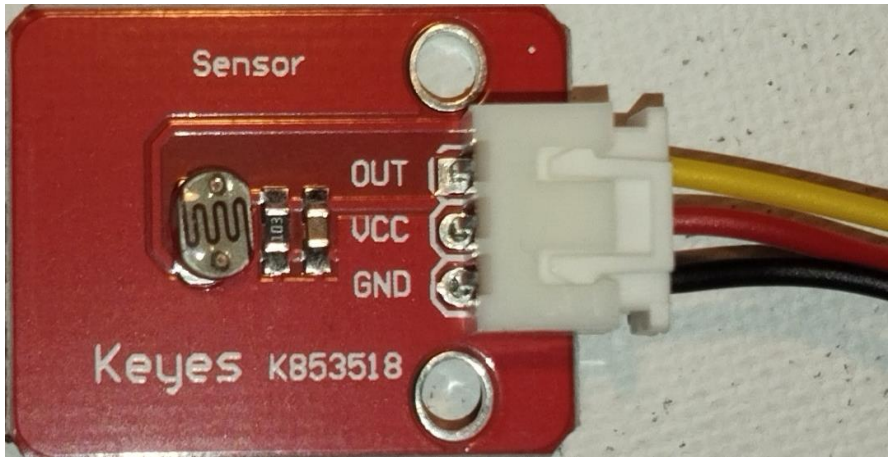
Photoresistor

Photoresistor Module – Detects light levels using a photoresistor (LDR - Light Dependent Resistor). **Resistance decreases with more light, changing the voltage, which the Arduino reads as an analog value.**



Wiring:
OUT – YELLOW – A0-A5
VCC – RED – +5V
GND – BLACK – GROUND

Coding:

```
1  void setup() {
2    Serial.begin(9600);
3    //Init A5 to INPUT mode
4    pinMode(A5, INPUT);
5  }
6
7  void loop() {
8    //Write input value to COM-port
9    Serial.println(analogRead(A5));
10   delay(100);
11 }
```

Parsing:
analogRead(A5) → 0 – 1023
Higher brightness → higher value

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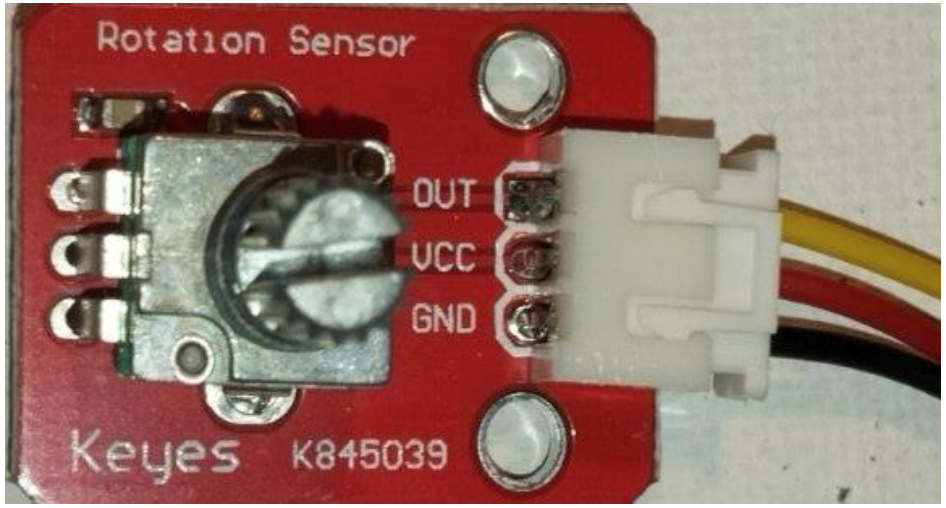
Variable resistor



Wiring:

OUT – YELLOW – A0-A5
VCC – RED – +5V
GND – BLACK – GROUND

Variable Resistor Module – A variable resistor with a rotating knob. **Turning it changes resistance, altering the output voltage, which the Arduino reads as an analog value.**

Parsing:

analogRead(A5) → 0 – 1023
extreme counterclockwise position → 0
extreme clockwise position → 1023

Coding:

```
1   void setup() {
2     Serial.begin(9600);
3     //Init A5 to INPUT mode
4     pinMode(A5, INPUT);
5   }
6
7   void loop() {
8     //Write input value to COM-port
9     Serial.println(analogRead(A5));
10    delay(100);
11  }
```

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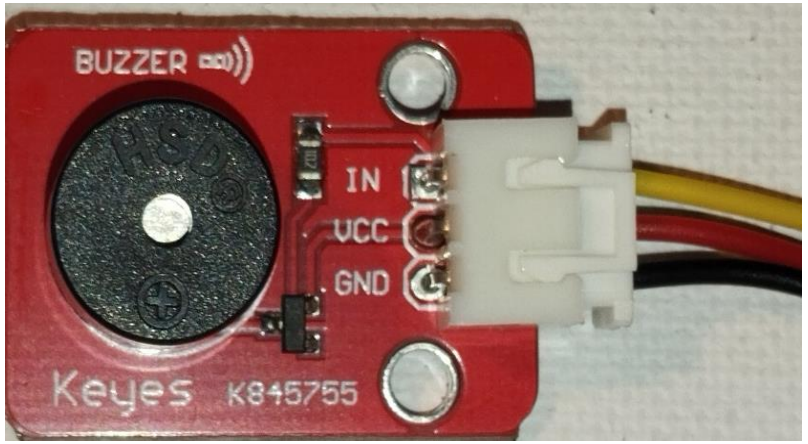
Buzzer



Wiring:
IN – YELLOW – D0-D13
VCC – RED – +5V
GND – BLACK – GROUND

Active Buzzer Module – **Produces sound when powered.**
It has a built-in oscillator, so **it beeps with just a HIGH signal from the Arduino.**

Parsing:
digitalWrite(2, HIGH) → turn buzzer on
digitalWrite(2, LOW) → turn buzzer off

Coding:

```
1  void setup() {
2    //Init D2 to OUTPUT mode
3    pinMode(2, OUTPUT);
4  }
5
6  void loop() {
7    //Turn bzuzzer on
8    digitalWrite(2, HIGH);
9    delay(500);
10   //Turn buzzer off
11   digitalWrite(2, LOW);
12   delay(500);
13 }
```

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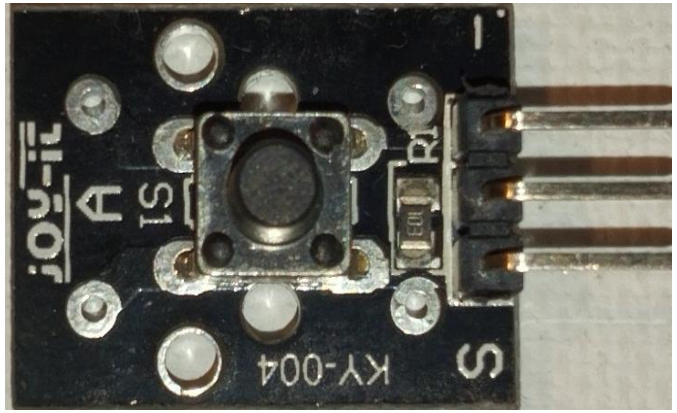
Button



Wiring:

– – GROUND
middle – +5V
S – SIGNAL – D0-D13

Button Module – A push-button with a built-in pull-up resistor. **When pressed**, it connects to GND, making **the output LOW. When released, the output is HIGH.**

Parsing:

digitalRead(2) → 0 or 1
Button pressed → 0
Button not pressed → 1

Coding:

```
1   void setup() {
2     Serial.begin(9600);
3     //Init D2 to INPUT mode
4     pinMode(2, INPUT);
5   }
6
7   void loop() {
8     //Write input value to COM-port
9     Serial.println(digitalRead(2));
10    delay(100);
11  }
12
```

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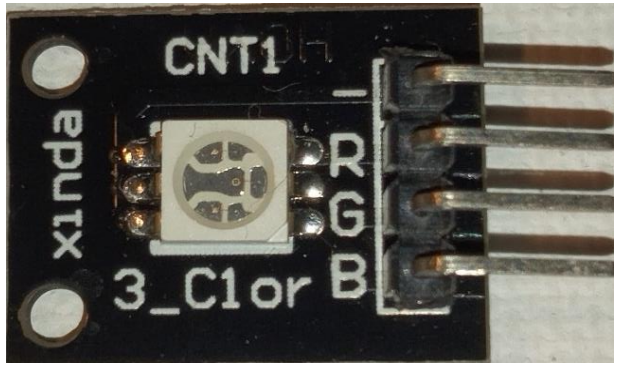
RGB LED

RGB LED Module – Contains Red, Green, and Blue LEDs in one package. **Adjusting PWM signals on each color pin mixes different colors.**



Wiring:

–	– GROUND
R	– RED – D0-D13
G	– GREEN – D0-D13
B	– BLUE – D0-D13

Coding:

```
1   void setup() {
2     //Init D2, D3 and D4 to OUTPUT mode
3     pinMode(2, OUTPUT);
4     pinMode(3, OUTPUT);
5     pinMode(4, OUTPUT);
6   }
7
8   void loop() {
9     //Shining one LED at a time
10    digitalWrite(4, LOW);
11    digitalWrite(2, HIGH);
12    delay(1000);
13    digitalWrite(3, HIGH);
14    digitalWrite(2, LOW);
15    delay(1000);
16    digitalWrite(4, HIGH);
17    digitalWrite(3, LOW);
18    delay(1000);
19  }
```

Parsing:

digitalWrite(2, HIGH) → turn on LED on pin 2
digitalWrite(2, LOW) → turn off LED on pin 2

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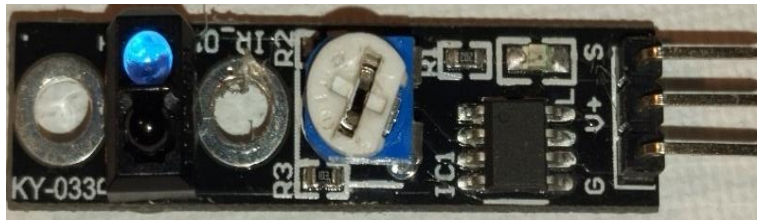
IR sensor

Line Tracking Sensor (Digital) – Uses an infrared sensor to detect dark or light surfaces. Outputs LOW on white (built-in LED ON) and HIGH on black (built-in LED OFF).



Wiring:

S	– SIGNAL – D0-D13
V+	– +5V
G	– GROUND

Coding:

```
1   void setup() {
2     Serial.begin(9600);
3     //Init D2 to INPUT mode
4     pinMode(2, INPUT);
5   }
6
7   void loop() {
8     //Write input value to COM-port
9     Serial.println(digitalRead(2));
10    delay(100);
11  }
12
```

Parsing:

digitalRead(2) → 0 or 1
Surface is white → 0 (LED is ON)
Surface is black → 1 (LED is OFF)

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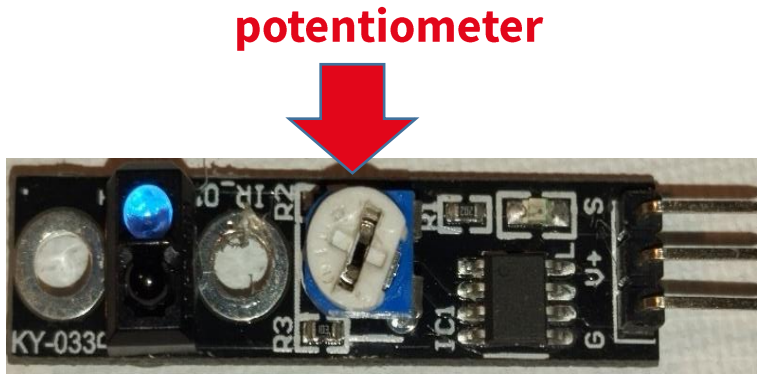
IR sensor



Wiring:

S	– SIGNAL – D0-D13
V+	– +5V
G	– GROUND

Sensitivity adjustment:

For reading custom barcodes with the **Line Tracking Sensor**, adjust the sensitivity using the **potentiometer** so it correctly differentiates between black and white areas. Turn:

- **Clockwise** → Increases sensitivity (detects lighter marks as black).
- **Counterclockwise** → Decreases sensitivity (requires darker marks to trigger).

Fine-tune it until the sensor reliably detects patterns.

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Servo motor (9g)

A 9g servo motor is a small and lightweight actuator that **rotates within a fixed range (typically 0-180°).**
It is controlled using PWM signals and is widely used in robotics, RC planes, and small automation projects.

Wiring:

YELLOW – D0-D13 (PWM)
RED – +5V
BLACK – GROUND

Tuning:

Replaceable caps

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Servo motor (9g)

```
#include <Servo.h>
Servo myservo;  // create Servo object to control a servo
// twelve Servo objects can be created on most boards
int pos = 0;    // variable to store the servo position
void setup() {
  myservo.attach(9);  // attaches the servo on pin 9 to the Servo object
}
void loop() {
  for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
    // in steps of 1 degree
    myservo.write(pos);              // tell servo to go to position in variable 'pos'
    delay(15);                       // waits 15 ms for the servo to reach the position
  }
  for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
    myservo.write(pos);              // tell servo to go to position in variable 'pos'
    delay(15);                       // waits 15 ms for the servo to reach the position
  }
}
```

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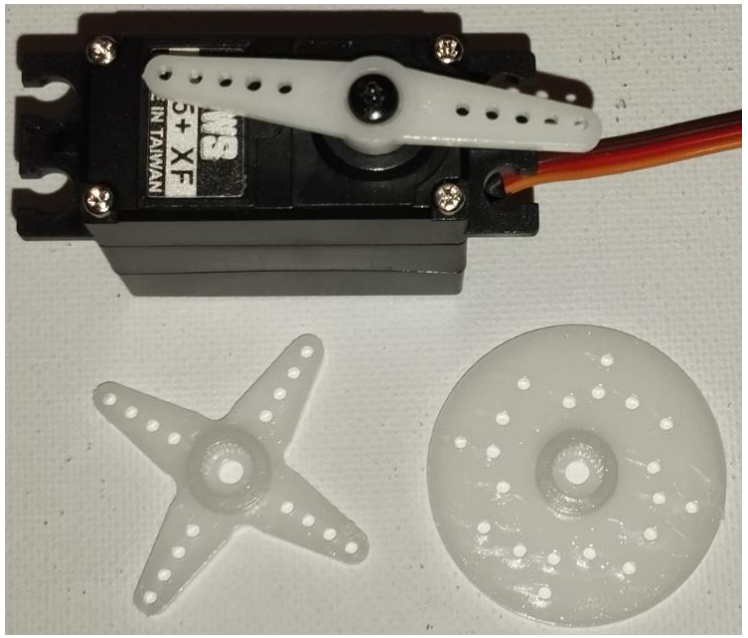
Servo motor (360°)

A continuous rotation servo is a modified **servo motor that can rotate 360° in either direction** instead of stopping at a fixed angle.
The speed and direction are controlled by PWM signals.



Wiring:

YELLOW – D0-D13 (PWM)
RED – +5V
BLACK – GROUND

Tuning:

Replaceable caps

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Servo motor (360°)

0-90-180 values for a Continuous Rotation Servo:

- 0 : Full speed in one direction (backward for most servos)
- 90 : Neutral position (stops the servo)
- 180 : Full speed in the opposite direction (forward for most servos)
- Values between 0-90 decrease the speed in the backward direction.
- Values between 90-180 decrease the speed in the forward direction.

```
#include <Servo.h>
Servo myServo;  // Create servo object
void setup() {
    myServo.attach(9);  // Attach the servo to pin 9
}
void loop() {
    // Rotate forward
    myServo.write(180);  // Full speed forward
    delay(2000);         // Run for 2 seconds
    // Stop
    myServo.write(90);   // Stop position
    delay(1000);         // Pause for 1 second
    // Rotate backward
    myServo.write(0);    // Full speed backward
    delay(2000);         // Run for 2 seconds
    // Stop again
    myServo.write(90);   // Stop position
    delay(1000);
}
```

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Display

A 16x2 LCD with I²C is a display module that **shows 16 characters per row on two rows.**
The I²C interface reduces the number of required pins (only SDA and SCL) compared to the standard parallel connection.

I²C address of the display is printed on the back

Wiring:

G	– GROUND
VCC	– +5V
SDA	– SDA (A4)
SCL	– SCL (A5)

Coding:

Install LiquidCrystal I2C library by Frank de Brabander via Library Manager

```
#include <LiquidCrystal_I2C.h>
// set the LCD address to 0x3F for a 16 chars and 2 line display
LiquidCrystal_I2C lcd(0x3F, 16, 2);
void setup() {
  lcd.init();                      // initialize the lcd
  lcd.backlight();                 //Turn on the backlight
  lcd.setCursor(0, 0);             //Set the cursor position
  lcd.print("Hello, world!");      // Print a message to the LCD.
  delay(1000);
  lcd.clear();                     //Clear the display
}
```

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Keypad

The PmodKYPD is a 4x4 matrix keypad with 16 buttons, commonly used for user input in microcontroller projects.
It connects using row-column scanning.

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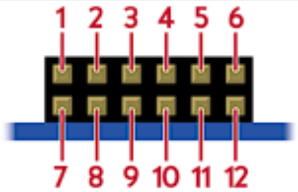
Keypad

J1 Pinout



Pin 1	COL4
Pin 2	COL3
Pin 3	COL2
Pin 4	COL1
Pin 5	GND
Pin 6	VCC
Pin 7	ROW4
Pin 8	ROW3
Pin 9	ROW2
Pin 10	ROW1
Pin 11	GND
Pin 12	VCC

Wiring:

VCC – +5V
GND – GROUND
other pins – D0-D13

Coding:

Get the KYPD library files from GitHub repo, add them into your sketch folder

```
#include <KYPD.h>
KYPD myKYPD;  // create KYPD object to control a keypad
unsigned int col[4] = { col1, col2, col3, col4 };
unsigned int row[4] = { row1, row2, row3, row4 };
int keyTable[4][4] = { { 49, 52, 55, 48 },    //Define keymap to the
                       { 50, 53, 56, 70 },    //values on the PmodKYPD
                       { 51, 54, 57, 69 },    //(This table contain
                       { 65, 66, 67, 68 } };  //corresponding ASCII
                                              //codes. You can copy-paste it)
void setup {
  Serial.begin(9600);
  myKYPD.setPins(row, col);    //set the pins
  myKYPD.setKeyMap(keyTable);
  myKYPD.begin();
}
void loop {
  int key = myKYPD.getKey();  //Returns -1 if no key pressed, otherwise
                              //returns corresponding value from keyTable.
  //Therefore, after checking for -1 key can be converted to char:
  if (key != -1)
    Serial.println((char)key);
}
```

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Radio module

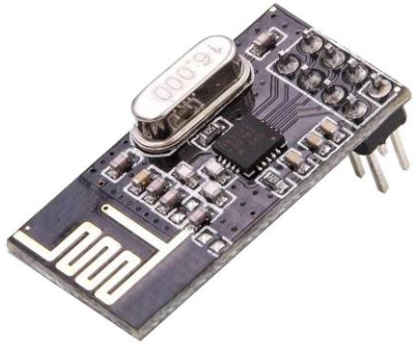
A **radio module** enables wireless data transmission using radio waves. It consists of a **transmitter** and **receiver** for communication between devices.

APC220

- **UHF (418–455MHz), UART-based** communication.
- **Up to 1 km range**, simple **serial interface**.

nRF24L01

- **2.4GHz transceiver, SPI-based** communication.
- **Short-range, fast data transfer**, supports multiple devices.



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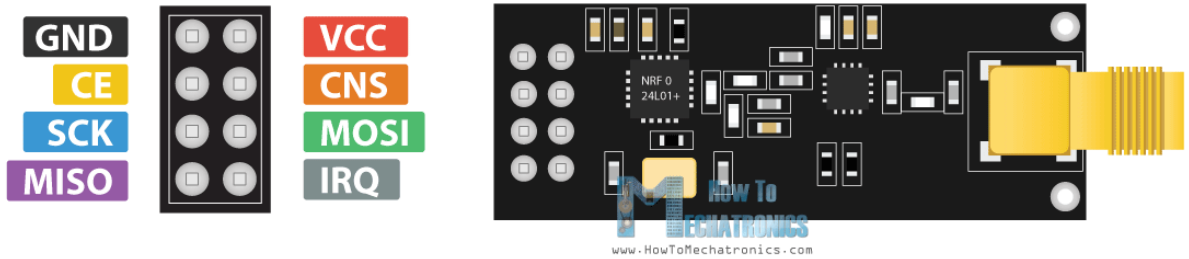
Radio module

Wiring:

GND	– GROUND
VCC	– +3.3V
MOSI	– D11
MISO	– D12
SCK	– D13
CE	– D0-D10
CNS	– D0-D10
IRQ	– not connected

NRF24L01 Pinout

NRF24L01+ PA/LNA Pinout



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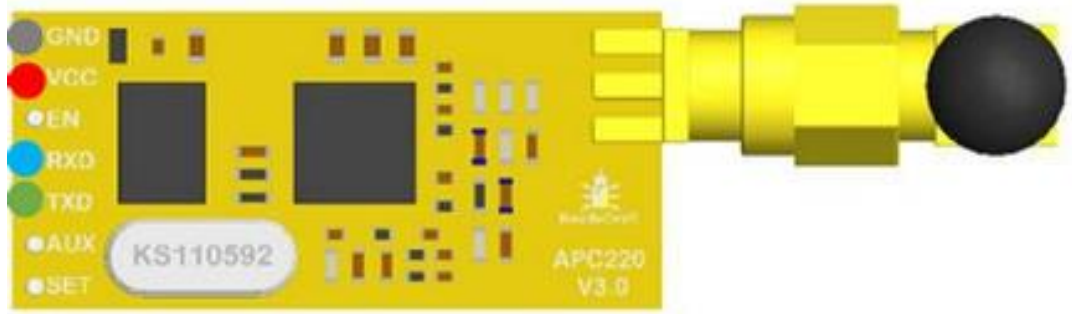
Radio module

Wiring:

GND	– GROUND
VCC	– +5V
RX	– D2-D13
TX	– D2-D13
SET	– D2-D13
EN	– not connected
AUX	– not connected



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Radio module

Install RF24 library by TMRh20 via Library Manager

Get the Radio library files from GitHub repo, add them into your sketch folder

```
#include "Radio.h"
Radio myRadio(APC220);                          //For both APC220
Radio myRadio(NRF24_1);                         //For one NRF24
Radio myRadio(NRF24_2);                         //For another NRF24

uint8_t rxPin = 2, txPin = 3, setPin = 4;   //For APC220
uint8_t cePin = 2, cnsPin = 3;              //For NRF24

```

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Radio module

```
 9  void setup() {
10    Serial.begin(9600);
11    if (!myRadio.begin<channel>(rxPin, txPin, setPin))  //For APC220
12      Serial.println("Radio begin failed");
13
14    if (!myRadio.begin<channel>(cePin, cnsPin))  //For NRF24
15      Serial.println("Radio begin failed");
16    //channel should be set from 1 to 10, different for each group
17    //and as a number, not variable
18  }
19
20  void loop() {
21    myRadio.write("Hi");                  //Send a message
22    if (myRadio.available())              //Check if the message is received
23      Serial.println(myRadio.read());  //Read the received message
24  }
```

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Warm up tasks

- The competition will start tomorrow, before which you will need to familiarise yourself with the equipment at hand.
- For this we prepared a number of warm ups

- Make a numpad connected to arduino input numbers into IDE console using serial connection.
- Make an Arduino application that gives a number 0 to 9 every second to console depending on the knob position of variable resistor.
- Print “Hello world” to display.
- Send “Hello world” on radio module. Receive it.
- Make a blue servo do a 180°, 90°, back and forth.
- Make a 360° servo move. Now move it back.
- When photo resistor reads light, make the piezo speaker scream.
- See what IR sensor gives using serial. Point it at stuff.
- Lay your equipment into THE BOX carefully and present to jury for completion for practice. You can do it multiple times. Be our guest.