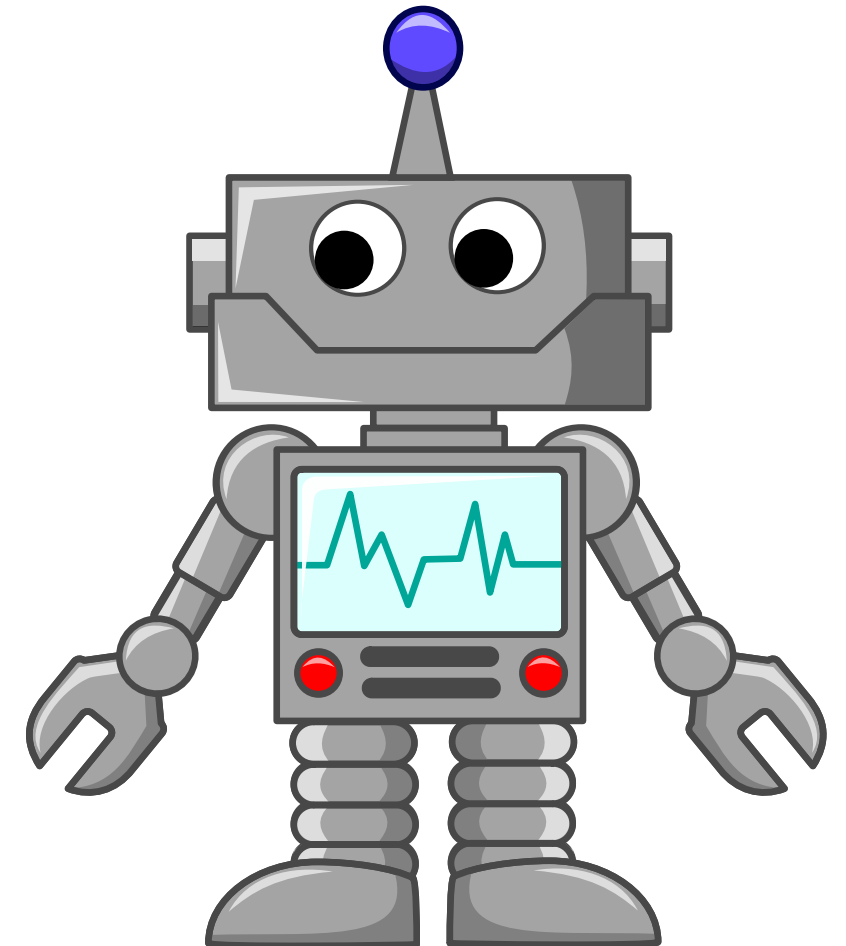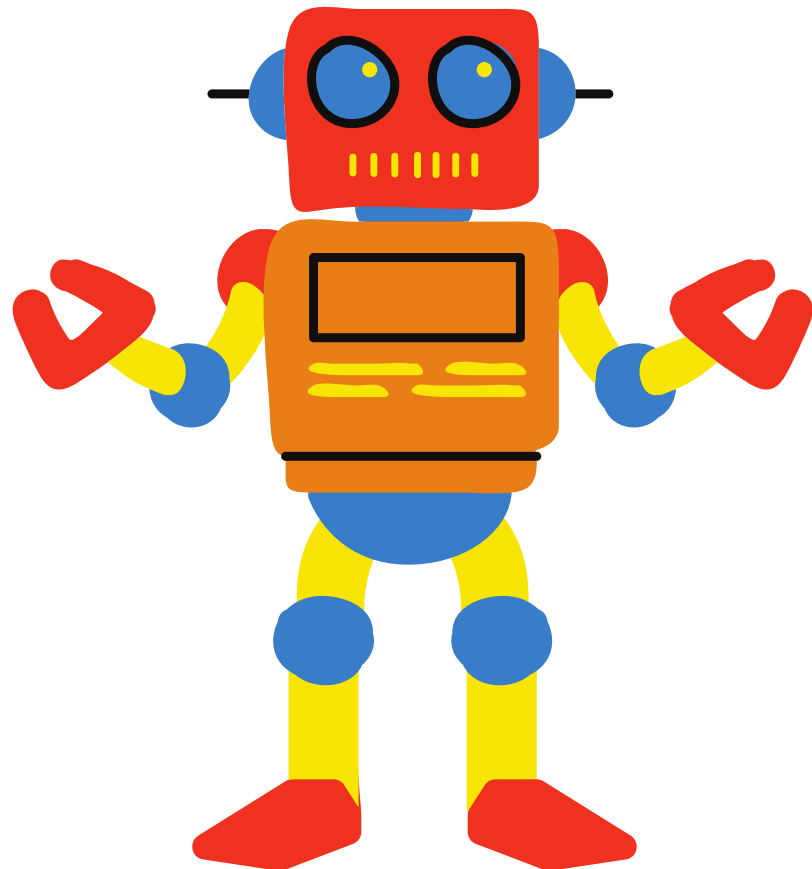# EMBEDDED SYSTEM DESIGN

By Divesh Jadhwani

INTRODUCTION MICRO CONTROLLERS?

DEFINITION: A MICROCONTROLLER IS A SMALL COMPUTING DEVICE ON A SINGLE INTEGRATED CIRCUIT.

IT CONTAINS A PROCESSOR, MEMORY, AND INPUT/OUTPUT PERIPHERALS.

FUNCTION: MICROCONTROLLERS ARE USED TO CONTROL VARIOUS DEVICES AND SYSTEMS BY EXECUTING PROGRAMMED INSTRUCTIONS.

TYPES OF MICRO CONTROLLERS
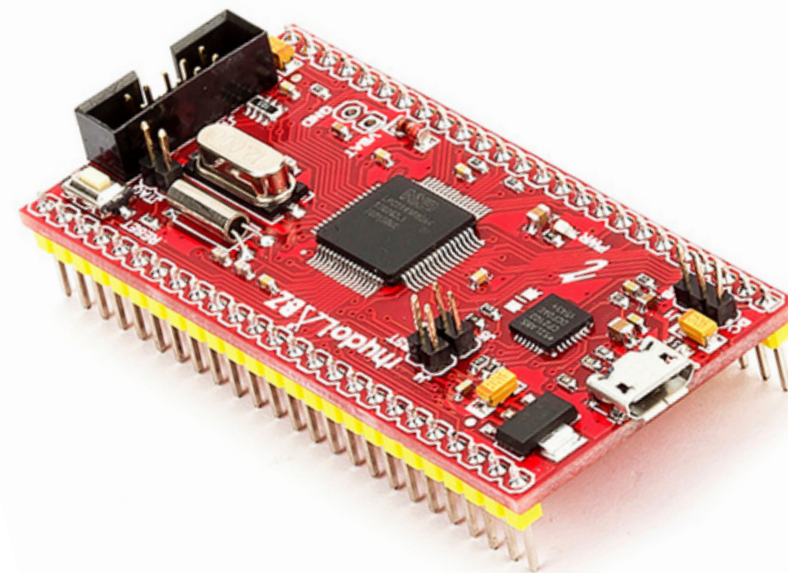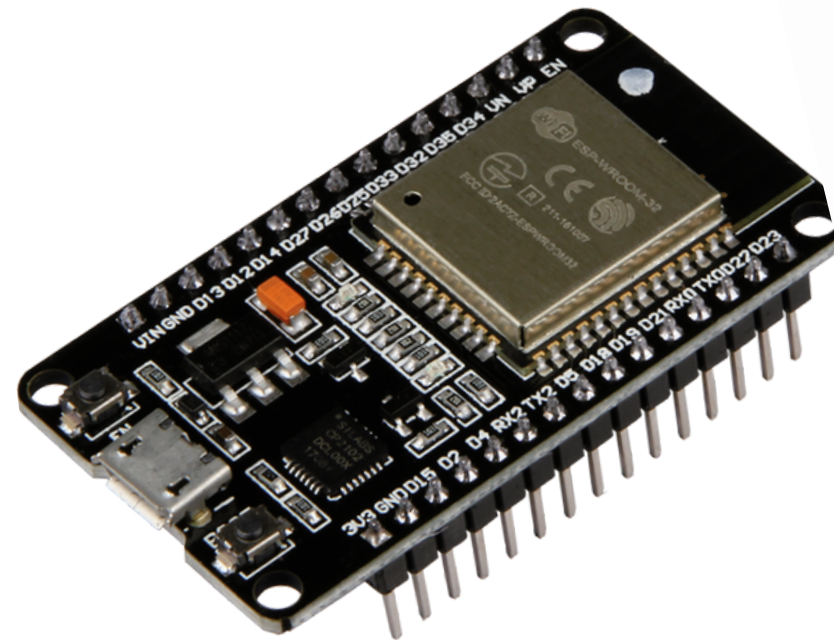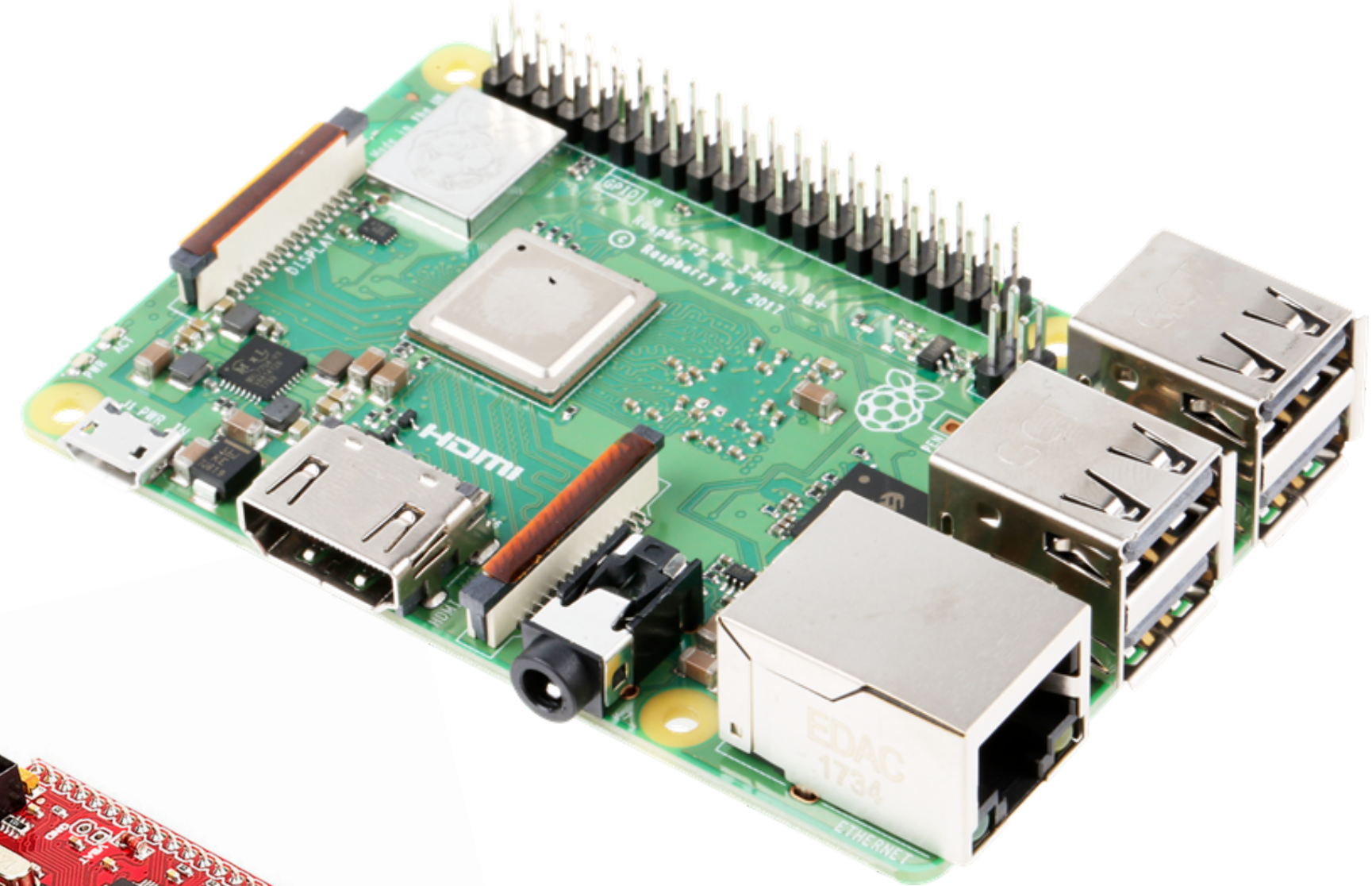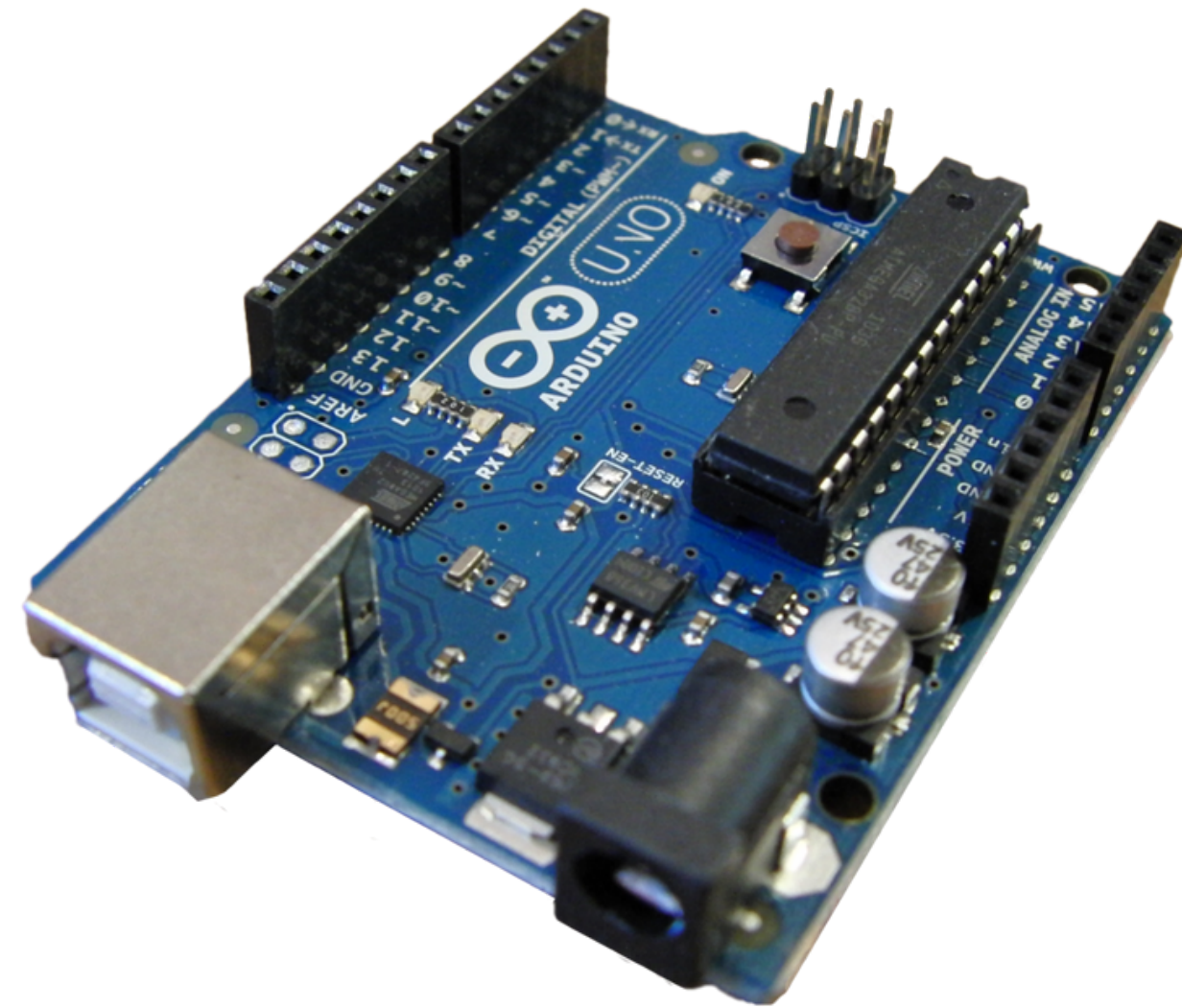
HOW TO CHOOSE MICRO CONTROLLERS

- **PROCESSING POWER NEEDED FOR THE TASK.**

- **REQUIRED MEMORY FOR PROGRAM AND DATA STORAGE.**

- **INPUT/OUTPUT REQUIREMENTS (ANALOG, DIGITAL, COMMUNICATION INTERFACES).**

- **COST CONSIDERATIONS FOR THE PROJECT.**

APPLICATIONS OF MICRO CONTROLLERS

- **HOME APPLIANCES: MICROWAVES, WASHING MACHINES, AIR CONDITIONERS.**

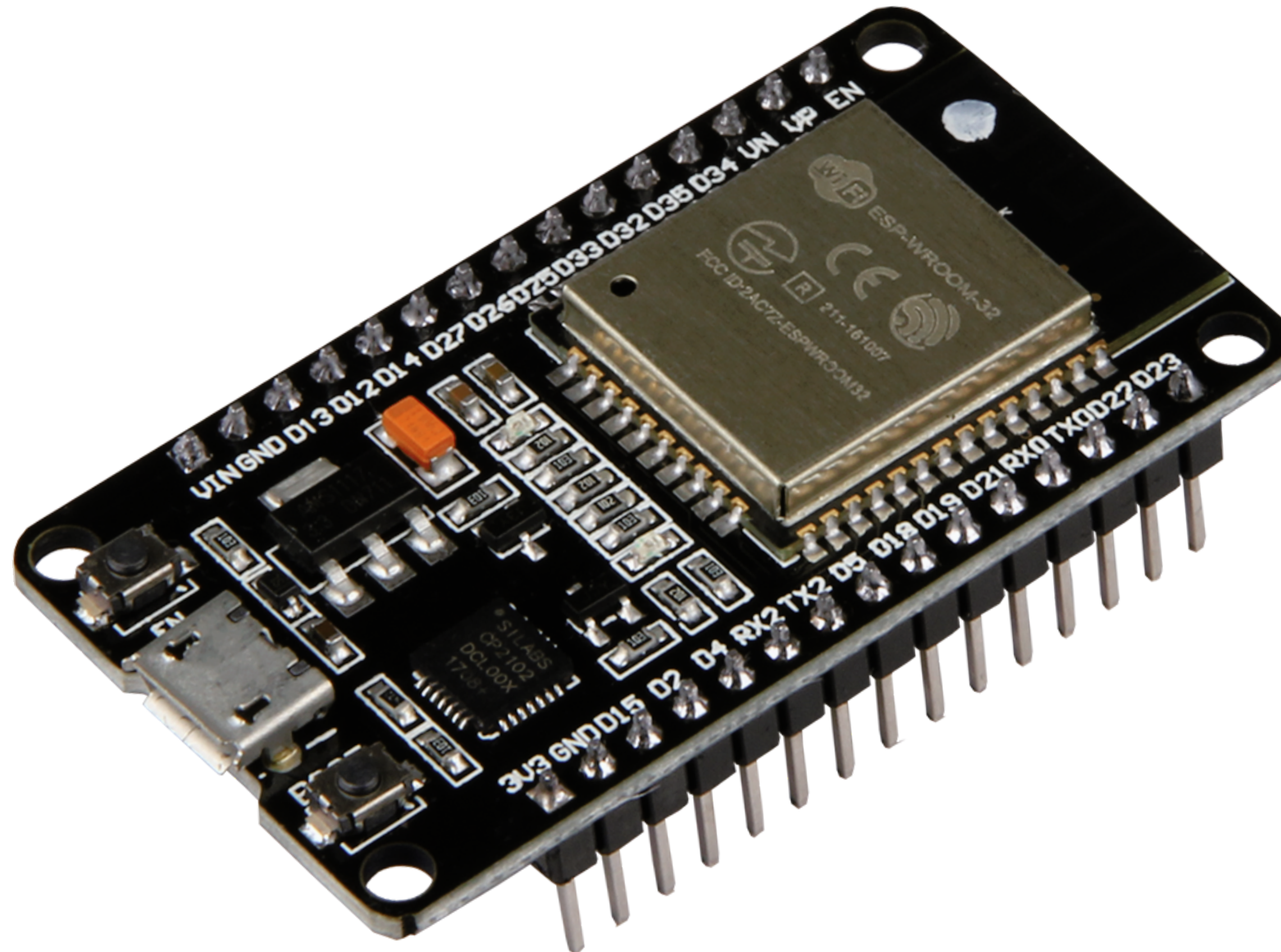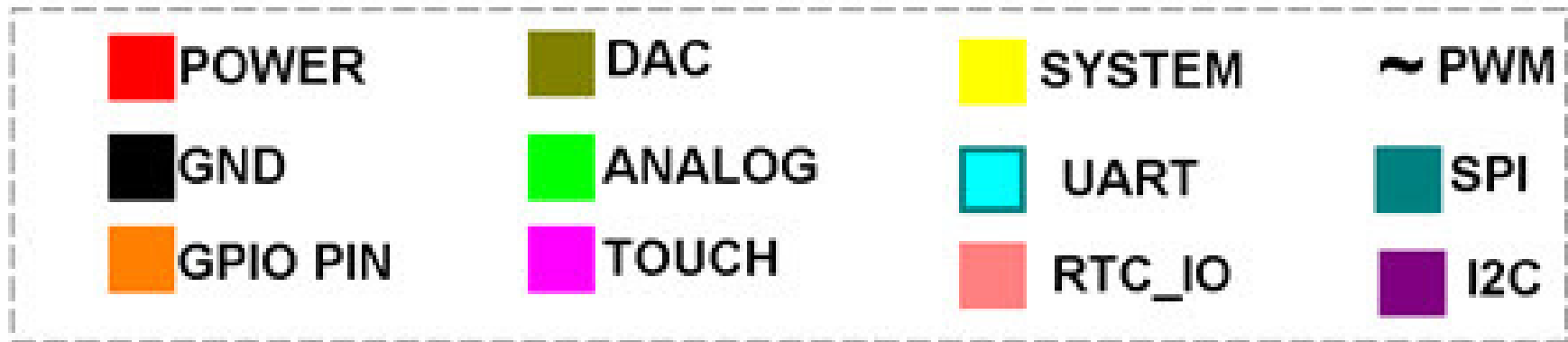- **AUTOMOTIVE: ENGINE CONTROL UNITS, ANTI-LOCK BRAKING SYSTEMS.**

- **CONSUMER ELECTRONICS: REMOTE CONTROLS, SMART TVS, GAMING CONSOLES.**

- **INDUSTRIAL AUTOMATION: PLCS, ROBOTICS, FACTORY AUTOMATION.**

- **HEALTHCARE: MEDICAL DEVICES, PATIENT MONITORING SYSTEMS.**

ESP32

ESP32 WROOM MODULE

ESP32 Pinout Diagram — ESP-WROOM-32

Left side pins:

Pin	Labels
1	EN
2	INPUT ONLY · SENSORVP · RTC_IO0 · ADC1_0 · ~GPIO36
3	INPUT ONLY · SENSORVN · RTC_IO3 · ADC1_3 · ~GPIO39
4	INPUT ONLY · RTC_IO4 · ADC1_6 · ~GPIO34
5	INPUT ONLY · RTC_IO5 · ADC1_7 · ~GPIO35
6	XTAL_32_P · TOUCH9 · RTC_IO9 · ADC1_4 · ~GPIO32
7	XTAL_32_N · TOUCH8 · RTC_IO8 · ADC1_5 · ~GPIO33
8	DAC_1 · RTC_IO6 · ADC2_8 · ~GPIO25
9	DAC_2 · RTC_IO7 · ADC2_9 · ~GPIO26
10	TOUCH7 · RTC_IO17 · ADC2_7 · ~GPIO27
11	HSPI_CLK · TOUCH6 · RTC_IO16 · ADC2_6 · ~GPIO14
12	HSPI_MISO · TOUCH5 · RTC_IO15 · ADC2_5 · ~GPIO12
13	HSPI_MOSI · TOUCH4 · RTC_IO14 · ADC2_4 · ~GPIO13
14	GND
15	VIN

Right side pins:

Pin	Labels
30	~GPIO23 · VSPI_MOSI
29	~GPIO22 · SCL
28	~GPIO1 · UART0_TXD
27	~GPIO3 · UART0_RXD
26	~GPIO21 · SDA
25	~GPIO19 · VSPI_MISO
24	~GPIO18 · VSPI_CLK
23	~GPIO5 · VSPI_CS0
22	~GPIO17 · UART2_TXD
21	~GPIO16 · UART2_RXD
20	~GPIO4 · ADC2_0 · RTC_IO10 · TOUCH0
19	~GPIO2 · ADC2_2 · RTC_IO12 · TOUCH2
18	~GPIO15 · ADC2_3 · RTC_IO13 · TOUCH3 · HSPI_CS0
17	GND
16	3V3

Legend:

- POWER
- GND
- GPIO PIN
- DAC
- ANALOG
- TOUCH
- SYSTEM
- UART
- RTC_IO
- ~ PWM
- SPI
- I2C

ELECTRONICS HUB

- 34 PROGRAMMABLE GPIOS
- 18 12-BIT ADC CHANNELS
- 2 8-BIT DAC CHANNELS
- 16 PWM CHANNELS
- 3 UART INTERFACES
- 3 SPI INTERFACES
- 2 I2C INTERFACES
- 2 I2S INTERFACES
- 10 CAPACITIVE TOUCH SENSING GPIOS
- 16 RTC GPIOS
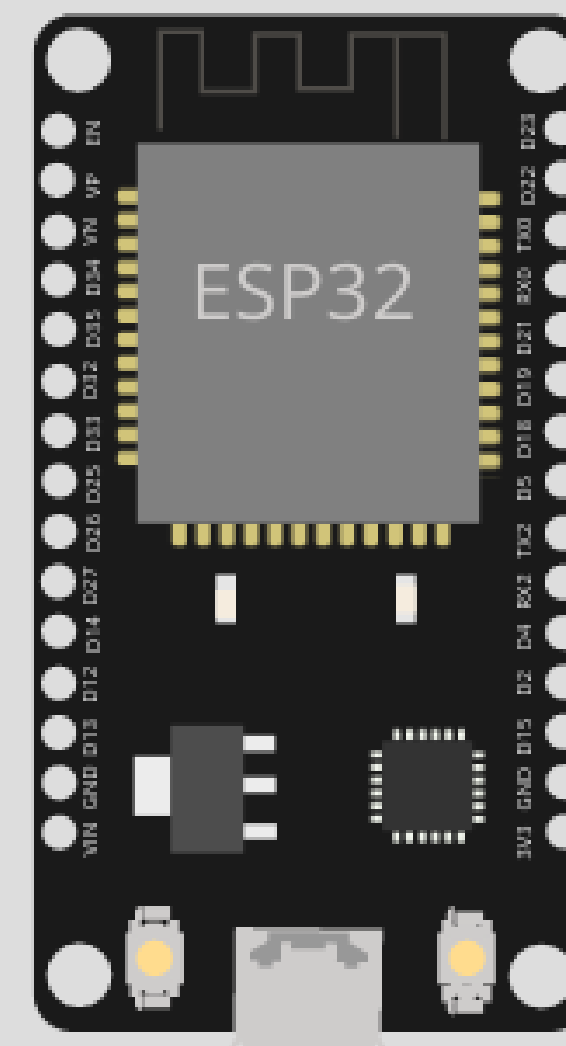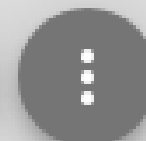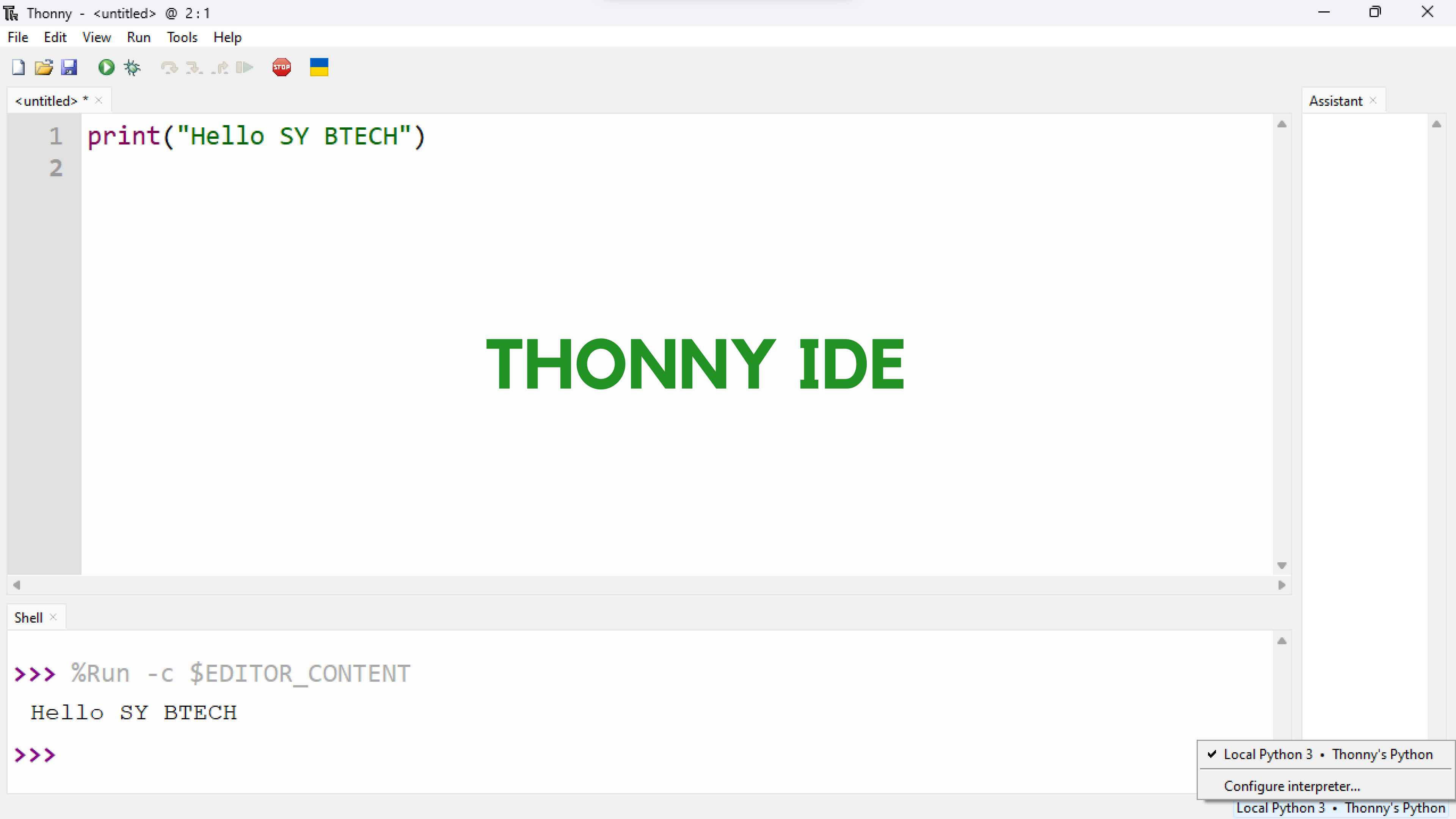
etch.ino   diagram.json   Library Manager

```
1  void setup() {
2    // put your setup code here, to run once:
3    Serial.begin(115200);
4    Serial.println("Hello, ESP32!");
5  }
6
7  void loop() {
8    // put your main code here, to run repeatedly:
9    delay(10); // this speeds up the simulation
10 }
11
```

Simulation

WOLKWI
ONLINE
SIMULATOR

ESP32

File   Edit   View   Run   Tools   Help

<untitled> *

```
1  print("Hello SY BTECH")
2
```

THONNY IDE

Assistant

Shell

```
>>> %Run -c $EDITOR_CONTENT
  Hello SY BTECH
>>>
```

✓ Local Python 3 • Thonny's Python

Configure interpreter...

Local Python 3 • Thonny's Python

THANK YOU

dypiu.ac.in