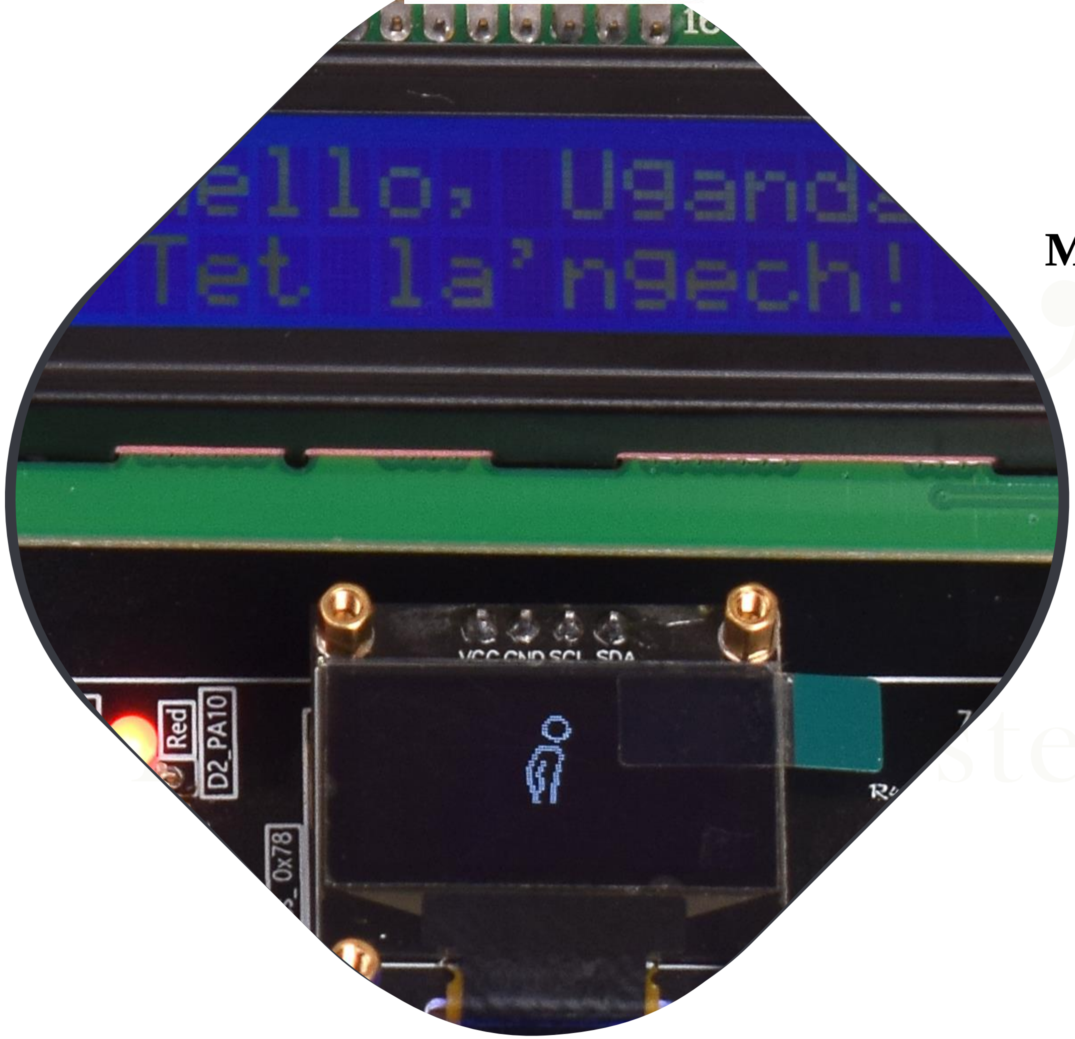
KYAMBOGO UNIVERSITY

Tet la'ngech

Embedded Systems Technology



MICROCONTROLLERS AND APPLICATIONS

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Prac session: Mr. Matovu Paul

Department of Electrical and Electronics Engineering

Embedded Systems

Serial Communication in STM32

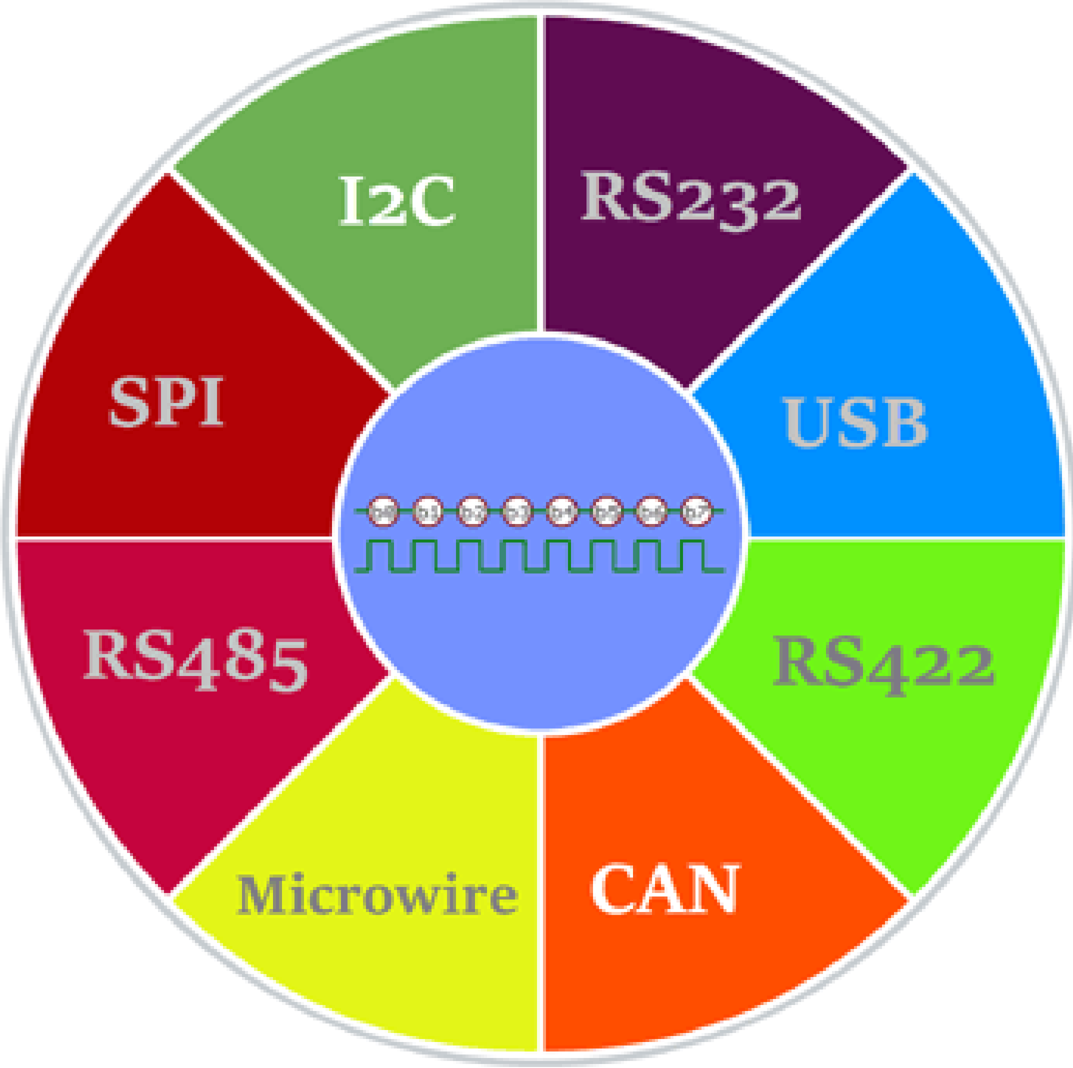
"Transforming Lives Through Advanced Embedded Systems Technology"

Serial Communication

- ❑ Serial communication is the process of sending data one bit at a time, sequentially.
- ❑ Communication between STM32 board and other modules (Transmit & Receive)

Serial Communication Protocols

- ❑ **UART (Universal Synchronous/Asynchronous Receiver Transmitter)**
- ❑ I2C (Inter integrated circuit)
- ❑ SPI (Serial Peripheral Interface)
- ❑ USB_OTG_(FS/HS) - Universal Serial Bus
- ❑ Etc…



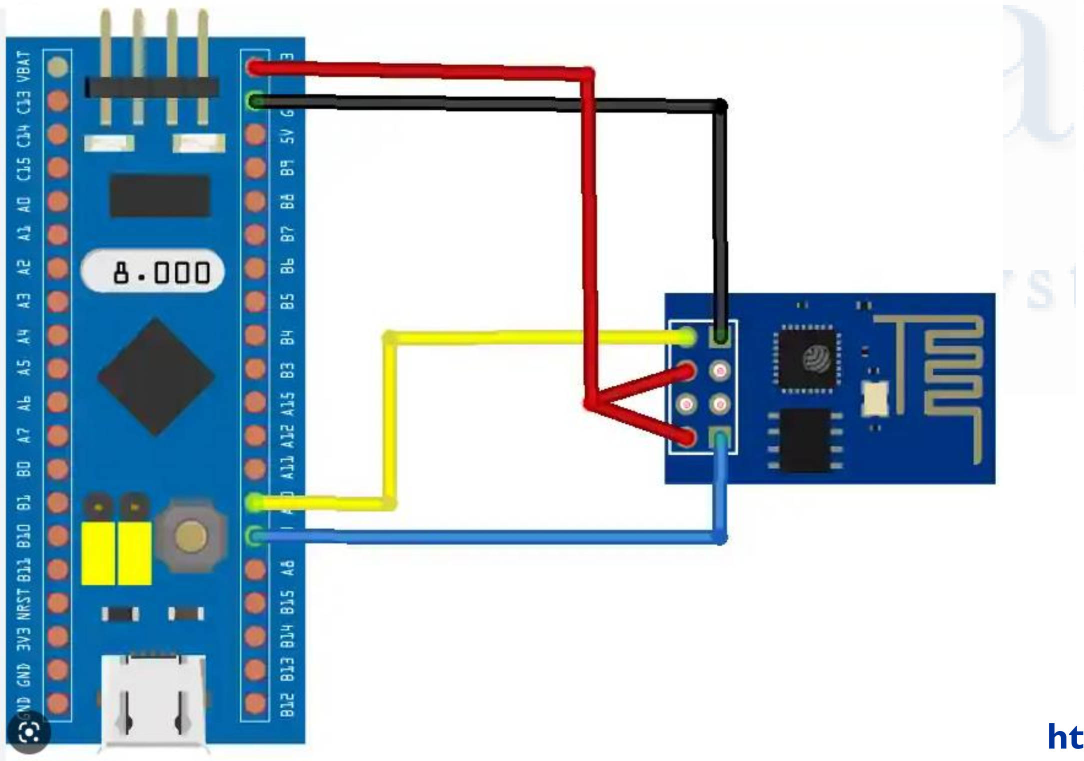
https://circuitdigest.com/tutorial/serial-communication-protocols

Serial Communication

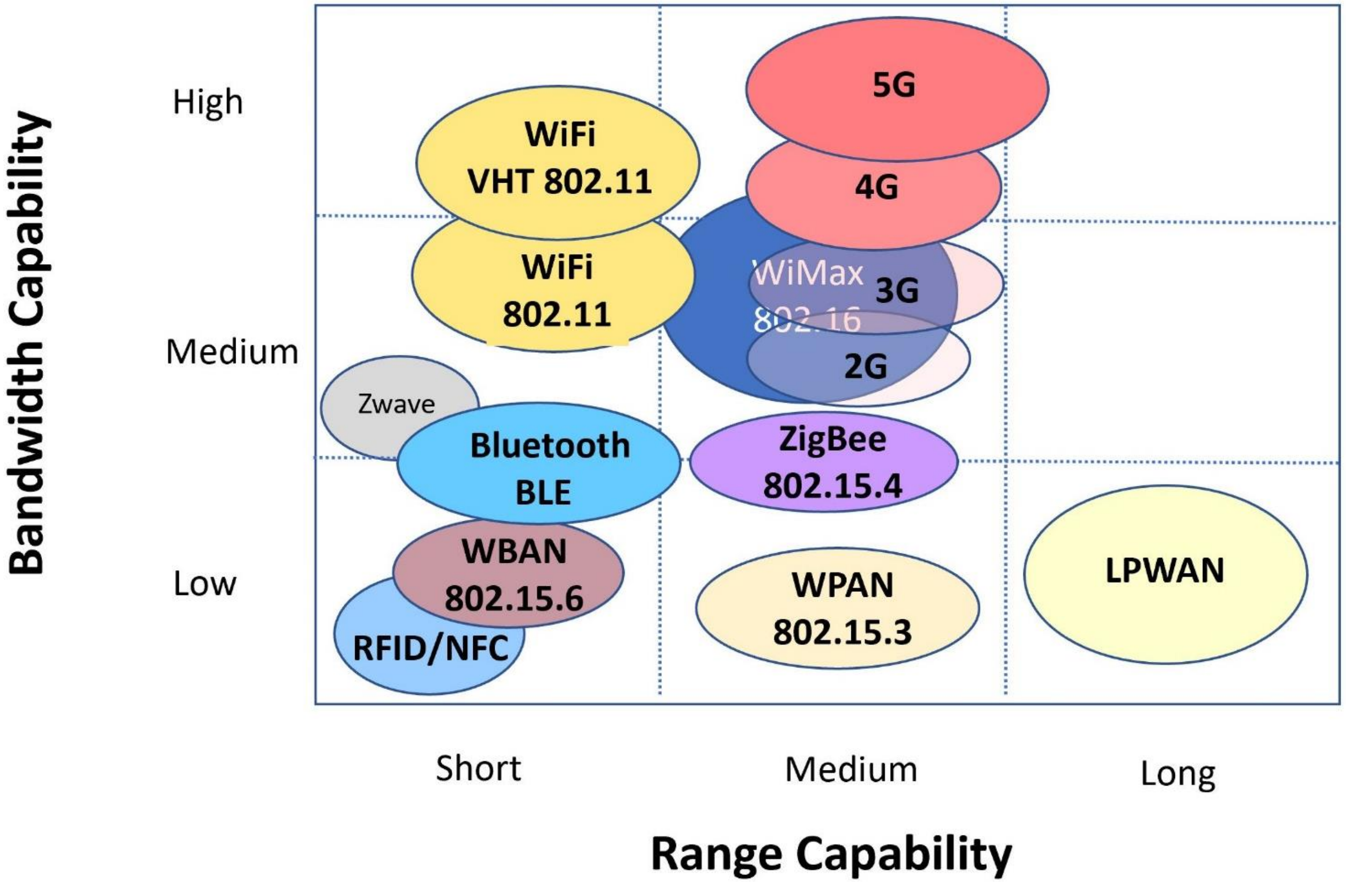
Wired & Wireless Communication

- ✓ Modules connected to STM32 through serial communication protocals
- ❑ RFID, Wifi, Bluetooth, LoRa, sd card, Etc…

Connection of Wifi Module to STM32 - UART



Comparison of Wireless Technologies



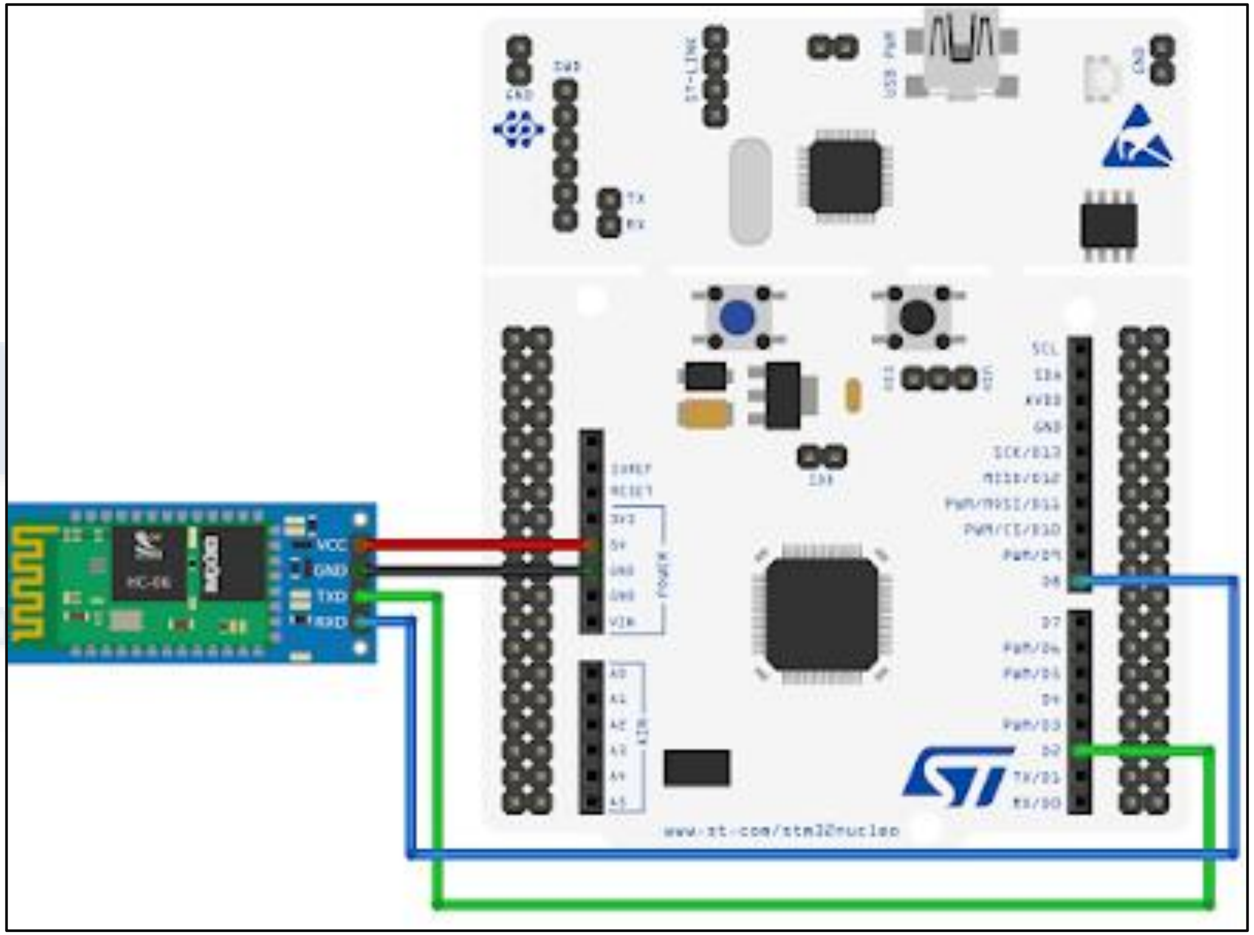
https://controllerstech.com/esp8266-webserver-using-stm32-hal/

Serial Communication: USART

Settings

- ❑ **Baud rate**: determines the speed of data transfer. Common baud rates: 75, 110, 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200 bit/s
- ❑ **Data bits/Word length**: Number of data bits in each character; 5,6,7,8,9. New/modern applications use 8
- ❑ **Parity**: method of detecting errors in transmission. Extra data bit is sent with each data character. None (N), Odd (O), Even (E), Mark (M), Space (S).
- ❑ **Stop bits**: sent at the end of every character. Options are 1, 1.5, 2.

Connection of Bluetooth Module to STM32 - UART



https://en.wikipedia.org/wiki/Serial_port

http://electroniqueamateur.blogspot.com/2017/07/module-bluetooth-hc-06-et-stm32-nucleo.html

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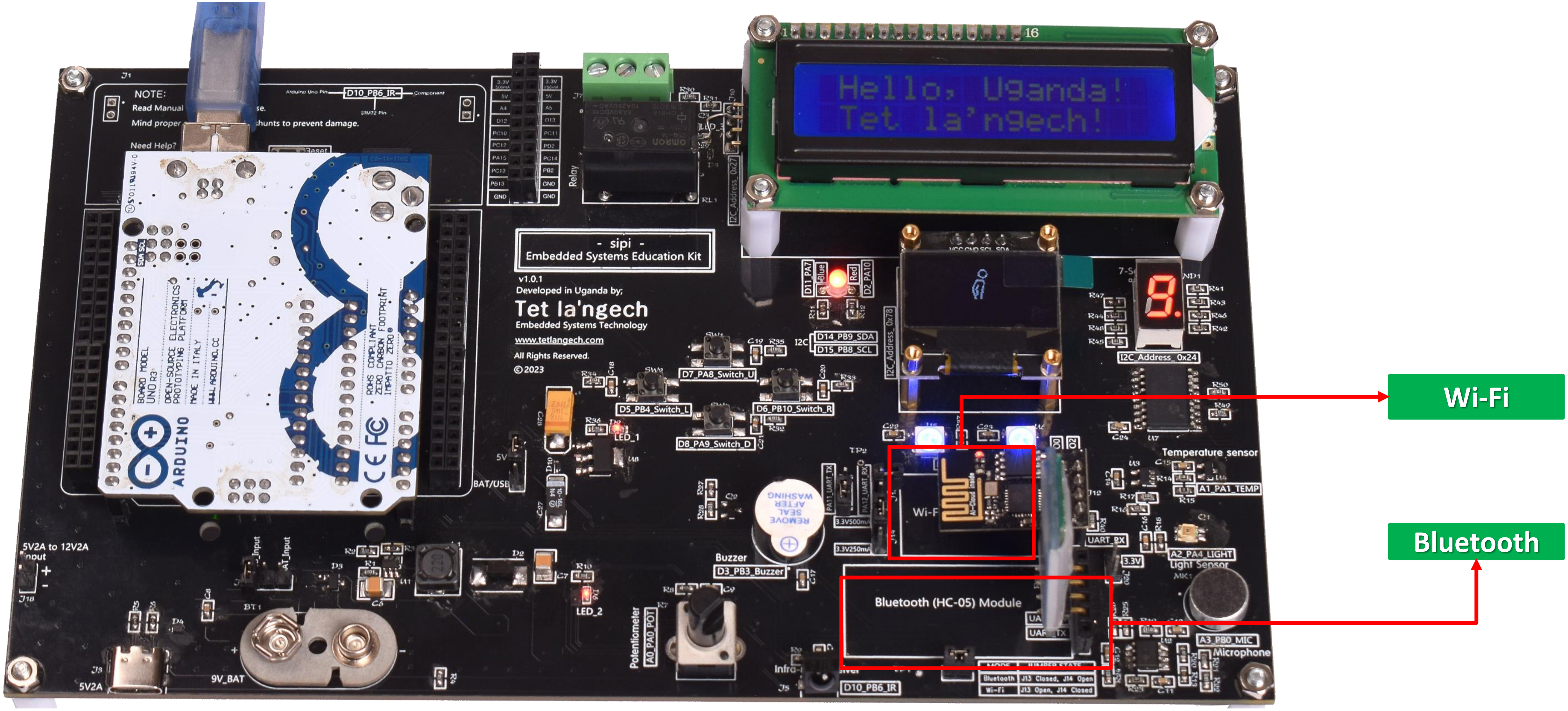
Serial Communication: USART



Connection of Wi-Fi & Bluetooth Module to sipi - UART

USART: Modes

Polling mode/blocking mode

❑ The CPU continuously checks the UART status, waiting until the transmission or reception is complete, preventing it from doing other tasks.

Interrupt mode

❑ UART triggers an interrupt when data is ready, allowing the CPU to perform other tasks until it's notified, making it more efficient than polling.

DMA mode

❑ Transfers data directly between memory and UART without CPU involvement, ideal for high-speed, large data transfers.

USART: Basic Functionalities

USART – Universal Synchronous and Asynchronous Receiver-Transmitter

❑ **Transmit - Transmit messages via serial COM port**

HAL_UART_Transmit(UART_HandleTypeDef *huart, uint8_t *pData, uint16_t Size, uint32_t Timeout)

HAL_UART_Transmit(UART Handle, Data to transmit, Size of data, Time to transmit data)

Sample application:

❑ Keep track the status of the program

Using STM32 serial terminal

Using external serial terminals eg Docklight, Hercules, Tera Term, Hterm etc

USART: Basic Functionalities

USART – Universal Synchronous and Asynchronous Receiver-Transmitter

❑ **Receive - Receive messages from serial COM port**

HAL_UART_Receive(UART_HandleTypeDef *huart, uint8_t *pData, uint16_t Size, uint32_t Timeout)

HAL_UART_Receive(UART Handle, Data to receive, Size of data, Time to receive data)

Sample application:

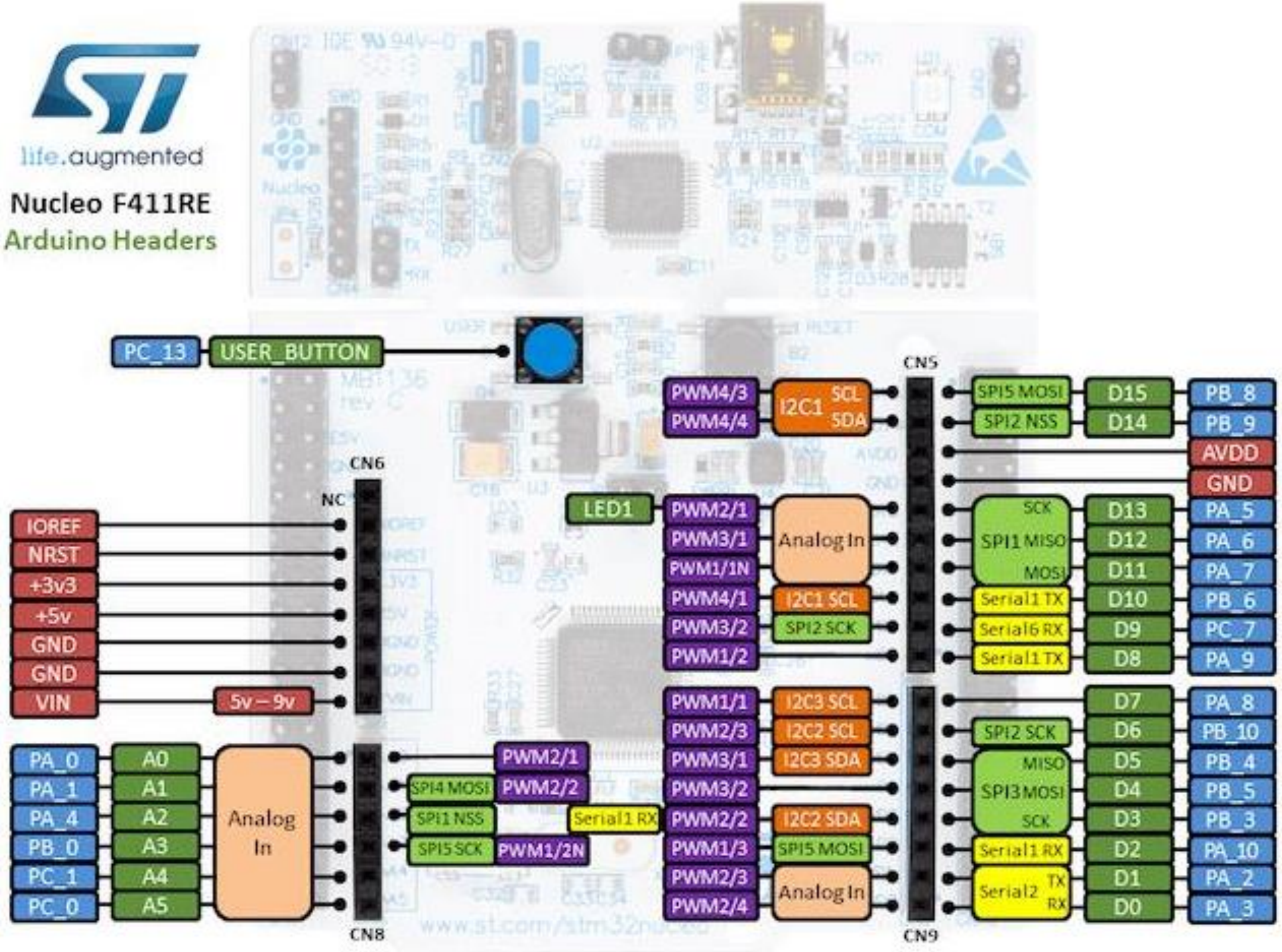
❑ Monitor the status of the program

❑ STM32 Receive commands from other modules

❑ Modes: Blocking, Interrupts, Direct Memory Access (DMA)

USART: Basic Functionalities

- ❑ Use serial 2 (UART2) for serial communication
- ❑ Serial 1 (UART1) & 6 (UART6) requires "serial to USB converter" module for serial communication.
- ❑ UART2 is connected to the onboard ST-Link debugger, which acts as a virtual COM port.



Task: Multiple values Via UART

1) Transmit and receive a data value of 6578 using UART (Decimal number system)

2) Transmit and receive a data value of 1100110110010 using UART (Binary number system)

3) Transmit and receive a data value of 0X19B2 using UART (Hexadecimal number system)

For each of the above, confirm transmission and reception of data using an LED on sipi

https://www.rapidtables.com/convert/number/decimal-to-hex.html