Programming Phase

Objectives:

Practice configuring and using the UART peripheral on the STM32 to communicate with a Bluetooth module. Learn to send and receive data from a mobile phone app, and control external devices based on received messages. Understand how to parse simple commands and map them to hardware actions.

Main Tasks:

For the following subtasks you are required to build the appropriate circuits on your breadboard using your The components from your KIT. The circuit should include two **push buttons** (PB1 and PB2), two **LEDs** (LED1 and LED2), and the **HC-06 Bluetooth module**. To power on the STM32 bluepill, you may use the TTL cable provided in the KIT.

Make sure to verify the connections with your mentor before powering on the STM32 board to ensure safety and correct wiring.

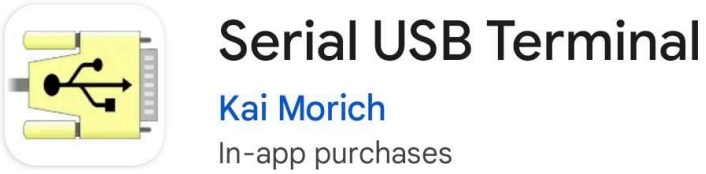
Subtask 1:

Write a documentation about the UART communication protocol, the documentation must contain the following topics:

- General discussion about serial communication in microcontrollers.
- Briefing on numbers systems (Decimal, Binary and Hexadecimal).
- Definition and modes of UART (Simplex, Half-duplex and Full-duplex).
- Differences between asynchronous and synchronous communication protocols.
- UART Frame Structure (Start bit, Data bits, Parity bit, and Stop bit)
- Baud Rate Definition, Common values and mismatch issues.
- Draw the signal diagram of a UART **message: 5** in binary, with **parity bit** set to **1**.

Fully AI documentations won't be accepted. Support your documentation with visualized content and list all resources used (websites, youtube videos, …).

For the following subtasks, you need to install the following application in your android device to be able to interact with the bluetooth module connected to the STM32.



Installation link on **Play Store**: https://play.google.com/store/apps/details?id=de.kai_morich.serial_usb_terminal

If you don't have access to any android device, you may use your laptop to interact with the STM32 using the TTL cable (instead of the HC-06 Bluetooth module) and the following software.

Installation link: https://serial-studio.com/download

Subtask 2:

Program your STM32 bluepill to transmit the message: "`Hello world!`" using the UART interface, then receive the message from your phone or laptop.

Subtask 3:

Write a code to receive data from your phone or laptop, then control the LEDs based on messages received. Each message consists of a **single character** (Exg. "a", "b", …).

- If the character received is: "a" to "f" switch LED1 on.
- If the character received is: "g" to "k" switch LED2 on.
- If the character received is: "l" to "p" switch both LED1 and LED2 off.

Subtask 4:

Write a program that controls a counter value, and transmit it using the UART interface. Reading the input data from the two push buttons, use PB1 to increment the value of the counter by 1, and PB2 to decrement it by 1. Whenever the value of the counter changes, transmit its value to your device (phone or laptop).

Optional Task:

- Repeat subtask 3 using UART receive interrupt.
- Repeat subtask 4 using UART transmit interrupt.

Hints:

- To pair an HC-06 with a device, ensure the module is powered and in pairing mode (flashing LED), then go to your device's Bluetooth settings and scan for new devices. Select the HC-06 from the list and enter the default PIN, 1234 or 0000. **Once connected, the LED on the module will change from a rapid blink to a solid light or slower flashing, indicating a successful connection**.
- For subtask 4, you will need to use the function ***sprintf()*** to be able to transmit the value of the counter using the UART interface.
- As part of our encouragement for you to not fully rely on AI to complete your tasks, the following are some helpful resources to help you to complete the task:
  - Why Do Computers Use 1s and 0s? Binary and Transistors Explained.
  - Basics of UART Communication | UART Frame Structure | RS 232 Basi...
  - Understanding UART
  - PROTOCOLS: UART - I2C - SPI - Serial communications #001
  - STM32 HC-05 Bluetooth Interfacing HAL Examples – Master & Slave Pairing AT Commands
  - STM32 UART #1 || How to configure Parameters || Send Data
  - Serial UART with STM32 Microcontroller-Transmit and Receive Data

Submission:

- Record a video explaining the circuit connections and the code and send it to your mentor.
- Send the main.c file to your mentor.
- Complete and submit this task in one PDF file for both main and optional (if done) tasks.
- Add a picture of your circuit connections to the PDF file.
- Add a screenshot of the configurations of IOC to the PDF file.
- Add a screenshot of the code of each subtask to the PDF file (only what you have modified in the generated code).
- Name the PDF files with task6_groupx_your_name, (replace x with your group number).
- This task should be submitted before 29th Aug 10:00pm (Malaysia time), 05:00pm (Makkah time).
- Your mentor must approve your task answer file before submission.
- Submit the PDF file to the Google form.