VILNIUS UNIVERSITY
SIAULIAI ACADEMY

PROGRAMŲ SISTEMOS BACHELOR STUDY PROGRAMME

Software engineering

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Programming of Embedded Systems
Laboratory work No.4
Virtual COM Port (VCP)

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Laboratory Work Report

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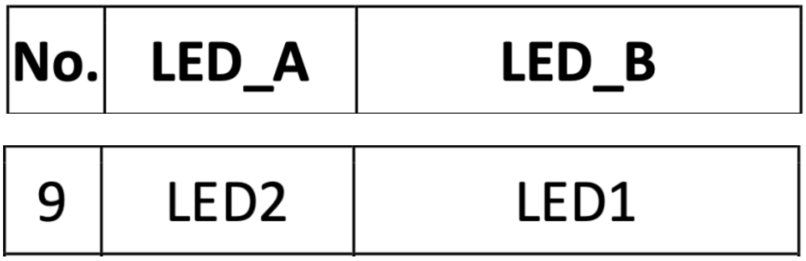
1. The Aim of the Laboratory Work

The purpose of this laboratory work is to study the Virtual COM Port (VCP) and implement data communication between a microcontroller and a PC via the USB-to-serial interface. The task involves developing a program that allowes:

- to turn ON / turn OFF LED_A
- to change the PWM signal duty cycle on LED_B (PWM frequency on your own choice)
- to receive the state of SW pin.

2. Variant No and Data

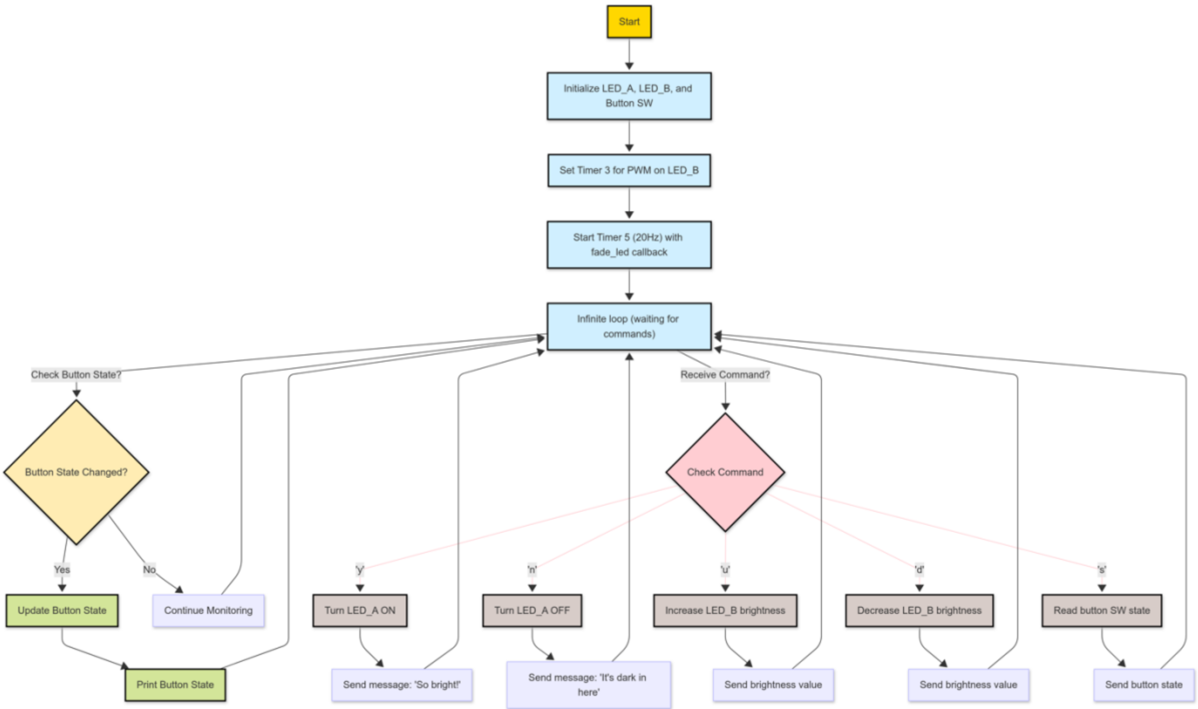
Variant No: 9



No.	LED_A	LED_B
9	LED2	LED1

Date: 04/03/2025

3. Program Algorithm



4. Program Body with Comments

```
from pyb import USB_VCP, Pin, Timer

# Initialize button SW
pin_SW = Pin("SW", Pin.IN, Pin.PULL_DOWN)

#-------- LED_A (on/off control)
vcp = USB_VCP()
blue_light = Pin("LED2", Pin.OUT)   # LED_A is LED2

#-------- LED_B (PWM control on LED1)
p = Pin("LED1")  # LED_B is LED1

# Set TIM3 frequency to 6000Hz
tim = Timer(3, freq=6000)

# Configure PWM on Channel 3
ch = tim.channel(3, Timer.PWM, pin=p)

# Initial PWM duty cycle
brightness = 0    # Start at 0%
step = 15          # Step for manual brightness change

def fade_led(timer):
    global brightness, step
    brightness += step
    if brightness >= 100 or brightness <= 0:
        step = -step  # Reverse direction
    ch.pulse_width_percent(brightness)

# Use timer interrupt to change brightness
```

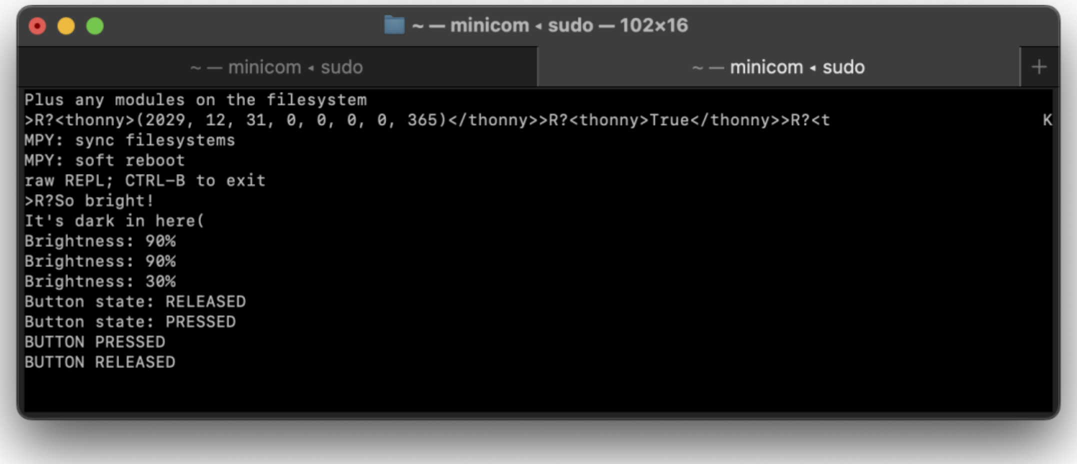
```python
fade_timer = Timer(5)
fade_timer.init(freq=20, callback=fade_led)  # 20Hz → period 50ms

# Initialize the button state
prev_state = pin_SW.value()

while True:
    cmd = vcp.recv(1, timeout=5000)  # Expecting 1-character commands
    if cmd:  # Check if cmd is not None
        if cmd == b'y':  # Turn LED_A ON
            blue_light.high()
            vcp.send("So bright! \r\n", timeout=5000)
        elif cmd == b'n':  # Turn LED_A OFF
            blue_light.low()
            vcp.send("It's dark in here( \r\n", timeout=5000)
        elif cmd == b'u':  # Increase LED_B brightness
            if brightness + step <= 100:
                brightness += step
            ch.pulse_width_percent(brightness)
            vcp.send(f"Brightness: {brightness}%\r\n", timeout=5000)
        elif cmd == b'd':  # Decrease LED_B brightness
            if brightness - step >= 0:
                brightness -= step
            ch.pulse_width_percent(brightness)
            vcp.send(f"Brightness: {brightness}%\r\n", timeout=5000)
        elif cmd == b's':  # Get button state
            state = "PRESSED" if pin_SW.value() else "RELEASED"
            vcp.send(f"Button state: {state}\r\n", timeout=5000)

    # Detect button state change
    current_state = pin_SW.value()
    if current_state != prev_state:
        if current_state:
            print("BUTTON PRESSED")
        else:
            print("BUTTON RELEASED")
        prev_state = current_state
```

5. Program screenshot



```
Plus any modules on the filesystem
>R?<thonny>(2029, 12, 31, 0, 0, 0, 0, 365)</thonny>>R?<thonny>True</thonny>>R?<t                  K
MPY: sync filesystems
MPY: soft reboot
raw REPL; CTRL-B to exit
>R?So bright!
It's dark in here(
Brightness: 90%
Brightness: 90%
Brightness: 30%
Button state: RELEASED
Button state: PRESSED
BUTTON PRESSED
BUTTON RELEASED
```

6. Conclusions

- Virtual COM Port (VCP) allows communication between a microcontroller and a PC using a USB connection.
- The program receives commands from the PC to control LED_A and adjust the brightness of LED_B using PWM.
- Messages are sent back to the PC to confirm actions, such as turning LED_A on/off.
- The microcontroller detects button state changes and prints the updated state.
- Using PWM and timers, the LED brightness smoothly changes without continuous manual control.
- This lab demonstrates how VCP can be used for real-time control and feedback in embedded systems.