VILNIUS UNIVERSITY
SIAULIAI ACADEMY

PROGRAMŲ SISTEMOS BACHELOR STUDY PROGRAMME

Software engineering

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Programming of Embedded Systems
Laboratory work No.1
I/O Ports

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Laboratory Work Report

1. The Aim of the Laboratory Work

The aim of this laboratory work is to develop a MicroPython program for the NUCLEO_F756ZG microcontroller that processes input signals from buttons and performs actions based on state changes. The program should detect transitions between logical levels (1 to 0 and 0 to 1) and execute specific operations accordingly.
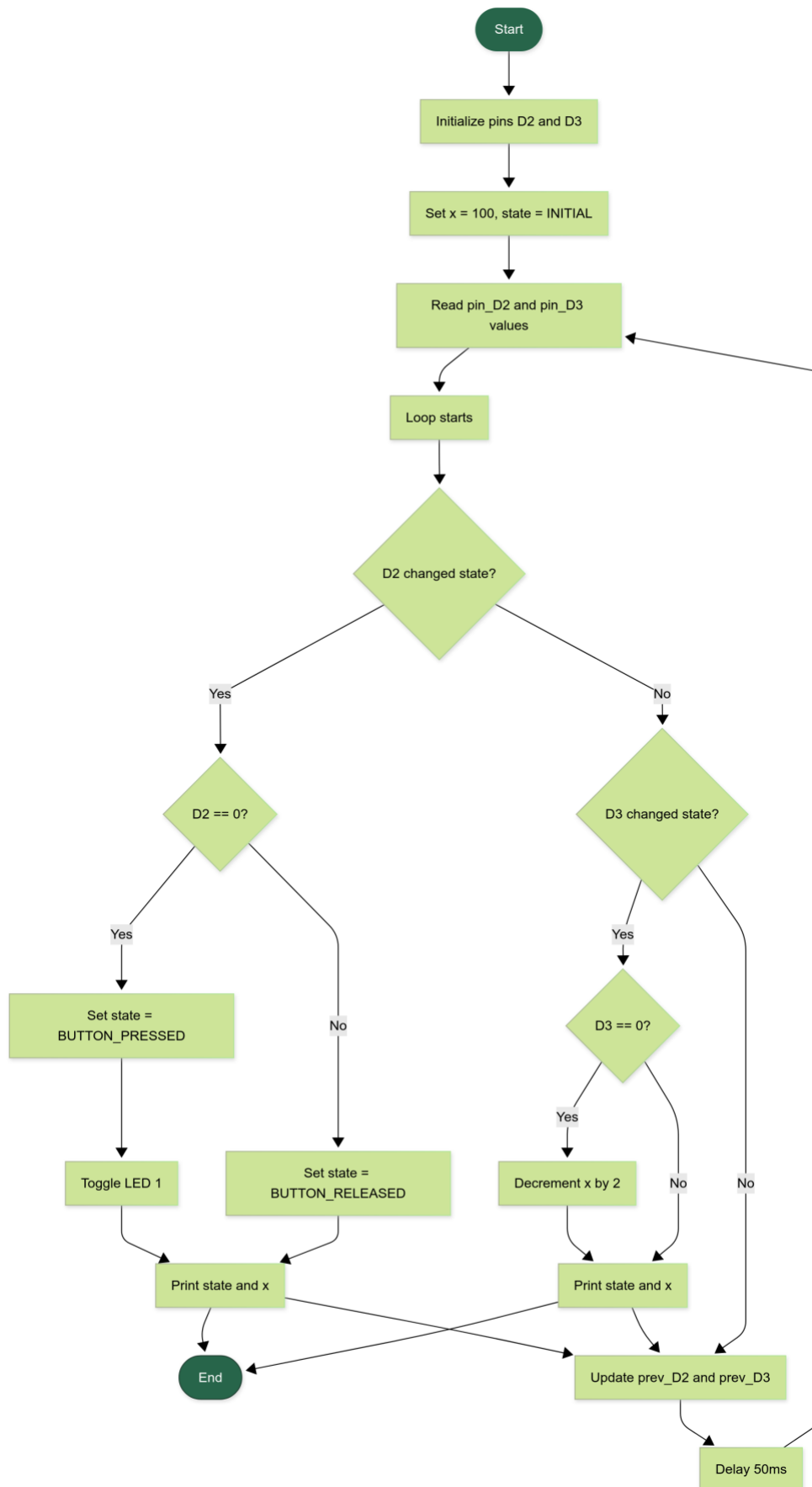
2. Variant No and Data

Variant No: 9

No.	Button 1			Button 2		
	Pin	Pull up /down	Action on button press	Pin	Pull up /down	Action on button release
9	D2	Pull up	Toggle LED3	D3	Pull down	Decrement variable

Date: 13/02/2025

3. Program Algorithm

```
Start
  │
  ▼
Initialize pins D2 and D3
  │
  ▼
Set x = 100, state = INITIAL
  │
  ▼
Read pin_D2 and pin_D3 values
  │
  ▼
Loop starts
  │
  ▼
D2 changed state?
  ├── Yes ──► D2 == 0?
  │            ├── Yes ──► Set state = BUTTON_PRESSED ──► Toggle LED 1 ──► Print state and x
  │            └── No ───► Set state = BUTTON_RELEASED ──► Print state and x
  │
  └── No ───► D3 changed state?
               ├── Yes ──► D3 == 0?
               │            ├── Yes ──► Decrement x by 2 ──► Print state and x
               │            └── No ───► Print state and x
               └── No ───► Update prev_D2 and prev_D3
```

Start

Initialize pins D2 and D3

Set x = 100, state = INITIAL

Read pin_D2 and pin_D3 values

Loop starts

D2 changed state?

Yes

No

D2 == 0?

D3 changed state?

Yes

No

Set state = BUTTON_PRESSED

Yes

No

D3 == 0?

Toggle LED 1

Set state = BUTTON_RELEASED

Yes

No

Decrement x by 2

Print state and x

Print state and x

End

Update prev_D2 and prev_D3

Delay 50ms

4. Program Body with Comments

```python
from machine import Pin
import time
import pyb

# Initialise input pins
pin_D2 = Pin("D2", Pin.IN, Pin.PULL_UP)  # Button with pull-up resistor
pin_D3 = Pin("D3", Pin.IN, Pin.PULL_DOWN)  # Button with pull-down resistor

x = 100  # Initial value
state = "INITIAL"

# Store previous states of the buttons
prev_D2 = pin_D2.value()
prev_D3 = pin_D3.value()

while True:
    # Read current states
    current_D2 = pin_D2.value()
    current_D3 = pin_D3.value()

    # Detect changes in D2
    if current_D2 != prev_D2:
        if current_D2 == 0:
            state = "BUTTON PRESSED"
            pyb.LED(1).toggle()  # Toggle LED when button is pressed
        else:
            state = "BUTTON RELEASED"

        print(f"State: {state}, x: {x}")

    # Detect changes in D3
    if current_D3 != prev_D3:
        if current_D3 == 0:
            x -= 2  # Decrease x only on state change
        print(f"State: {state}, x: {x}")

    # Update previous states
    prev_D2 = current_D2
    prev_D3 = current_D3

    # Small delay to reduce signal bouncing
    time.sleep_ms(50)
```

5. Conclusions

In this laboratory work, a MicroPython program was successfully developed for the NUCLEO_F756ZG microcontroller to process button inputs based on state changes. The program correctly detects transitions between logical levels and performs actions accordingly. This approach prevents continuous execution of the same action while a button is held down. The use of a small delay helps minimize signal bouncing. The experiment demonstrated how to work with GPIO, implement state tracking, and toggle LED outputs.