ITU Control & Automation Eng. Dept.

KON309E Microcontroller Systems

Experiment 1

Aim: Finite state machine design and application to Alakart using LEDs and buttons.

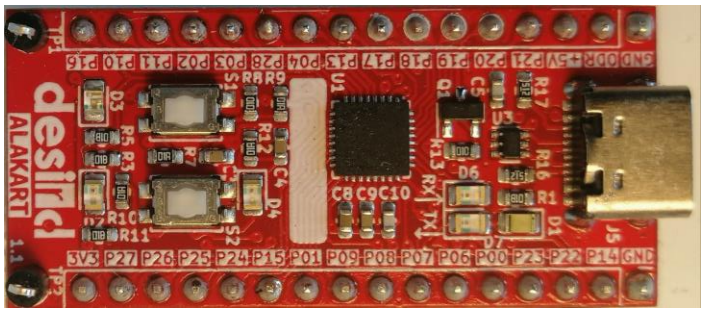


Figure 1 Alakart development board

For this experiment, you must have installed the development environment including the compiler and device programming software (lpc21isp or Flash-Magic) as described in the class. You will also need a USB-C cable to connect Alakart. All steps for installing the software are on Ninova class documents, as well as example code and reference documents such as LPC824 User Manual and LPC82x Datasheet.

The pinout of Alakart is given at the end of this document for your reference. More information is provided in Ninova class documents. **Check especially the schematic diagram (circuit diagram).**

PART I

In the first part of this experiment, finite state machine design and LED control application will be done by programming using **registers** as shown in class, and without using processor support library functions. To see the details about processor registers and how to program the peripheral devices, please visit LPC824 User Manual.

You are expected to complete **the tasks** below.

1 Design a finite state machine (FSM) according to the given instructions.

- At the start only the red LED will be **ON**.
- When B1 is pressed, the LEDs will cycle as: red, yellow, green, all off, all on, red etc.
- When B2 is pressed, the LEDs will cycle in the same sequence but will skip two places, i.e., red, green, all on, yellow, all off, red etc.

2 Draw your FSM design. You can use applications such as "draw.io"

3 Write the code that implements your FSM.

4 Construct a circuit consisting of 3 external LEDs (red, yellow, green) and two buttons B1 and B2 as the example in Figure 2.

5 Implement the code and program your Alakart.

PART II

In the second part of this experiment, the same application as in Part I will be repeated but using **peripheral library functions** instead of writing directly to registers.

Note: Please pay attention to the points below.

- Use **10kΩ pull up resistors** for buttons.
- Use **220Ω** series resistors for LEDs.
- The long pins of the LEDs are anodes.
- Connect V_{DD} (3.3V) and **Ground** pins of the microcontroller to the breadboard's (**+**) and (**–**) sockets via jumpers.
- The processor pins where the buttons are connected are set as digital inputs, and those where the LEDs are connected are set as digital outputs.
- Use **switch case** structure for coding the finite state machine (FSM).

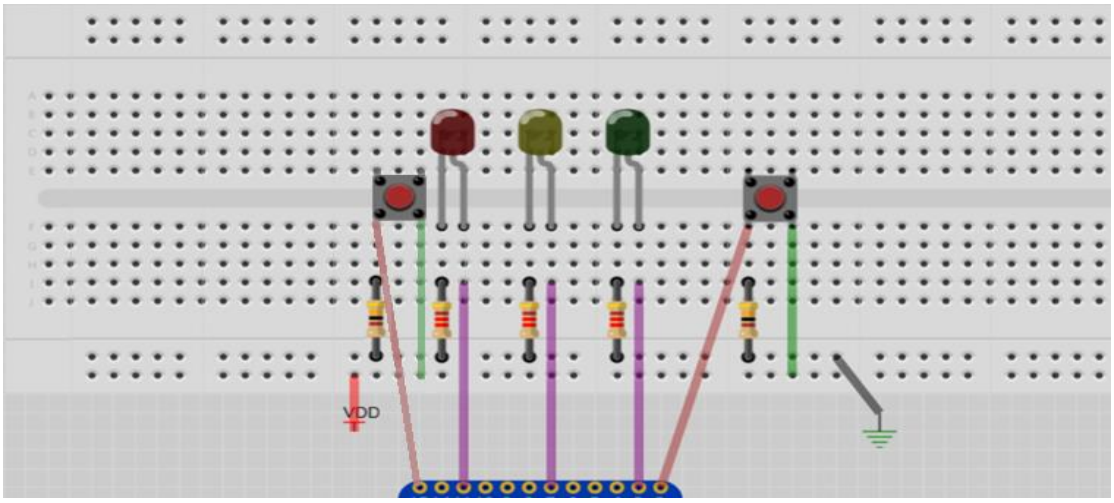
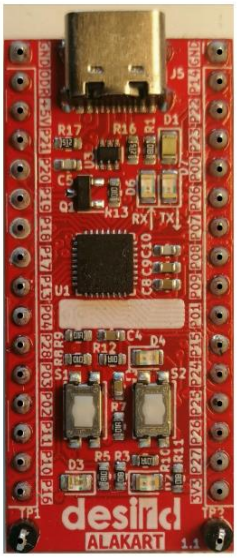


Figure 2 Wiring diagram for LEDs and buttons

Appendix: Pin connections of components on Alakart

- LEDs:
  - RED: D4 on GPIO PIN12
  - Blue: D3 on GPIO PIN16
  - Green: D2 on GPIO PIN27
  - White: D1 Power on
  - Green: D6 Transmit to PC
  - Red: D7 Transmit from PC
- Buttons:
  - S1: Reset
  - S2: ISP (enter boot mode)
    Also: User button.
- Red Pins: Test
  - TP1: GPIO PIN16
  - TP2: GPIO PIN27
- Purple Pin: Open drain FET
  - ODR: GPIO PIN21



GND	GND
ODR	P14
+5V	P22
P21	P23
P20	P00
P19	P06
P18	P07
P17	P08
P13	P09
P04	P01
P28	P15
P03	P24
P02	P25
P11	P26
P10	P27
P16	+3V3
TP1	TP2