

ECE3411 – Fall 2015

Lab 3a.

General Purpose Digital Input (Debouncing) Non-Blocking UART (using ISRs)

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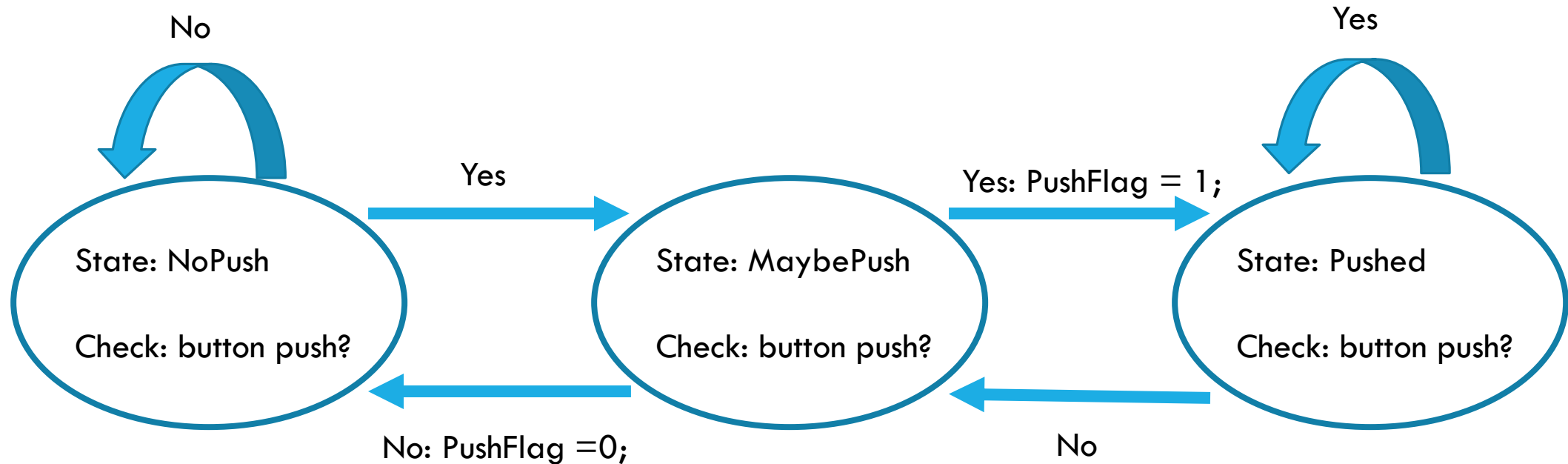


Recap

In the last lab, we implemented the following:

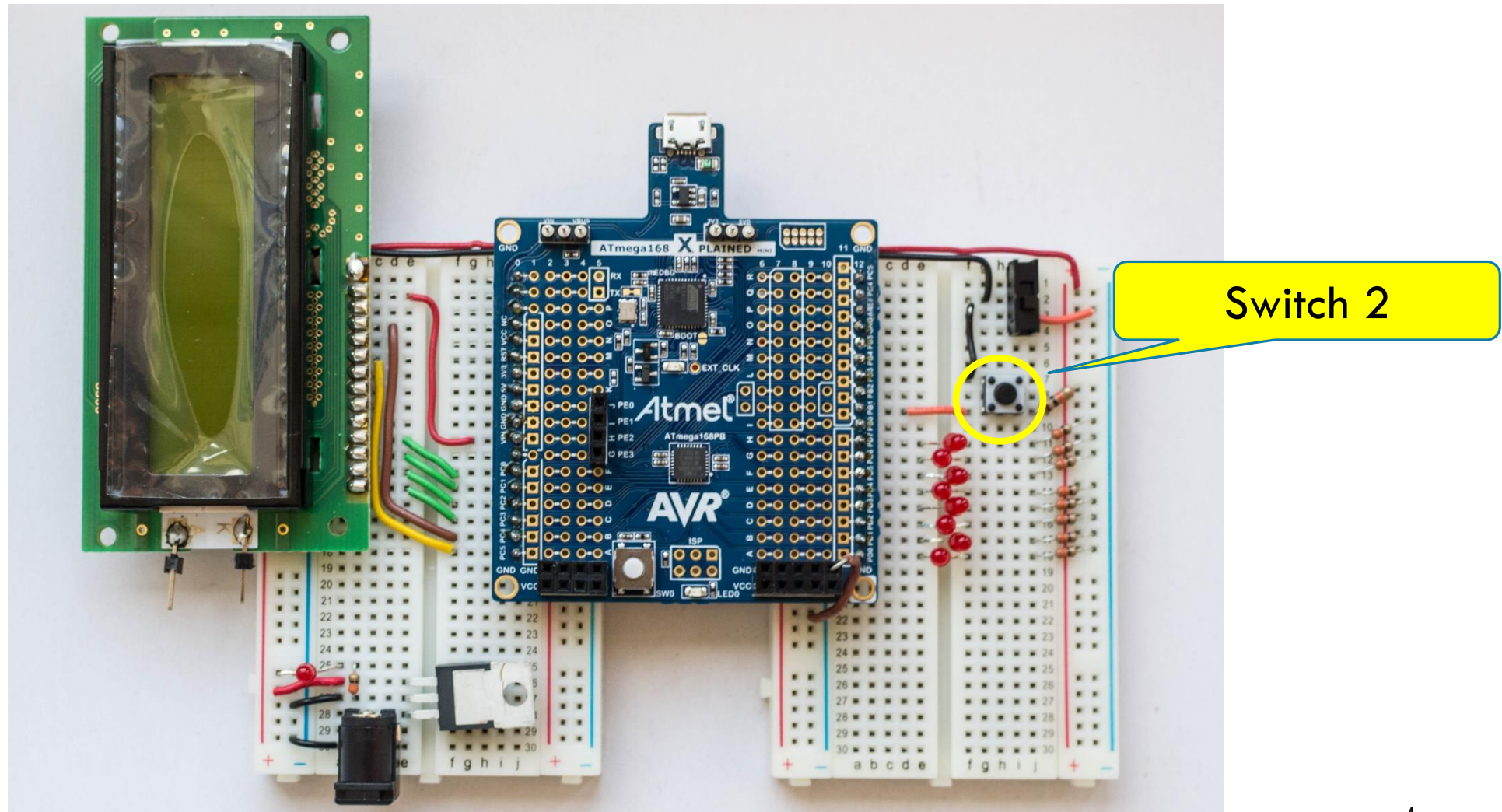
- Reading a Non-Debounced Switch
 - MCU may see a lot of glitches in the input from a Non-Debounced switch
- Reading a Debounced Switch
 - 3-state Debounce State Machine filters out glitches, but not all of them!
- Display some results on LCD

Do you see any problems with this Debounce State Machine?



- This state machine filters out glitches which result in **NoPush** → **MaybePush** → **NoPush** transitions
- What happens if a glitch causes **Pushed** → **MaybePush** → **Pushed** transitions sequence?
 - The software mistakenly thinks that a new button-push has occurred
 - Fix this problem in Task 1 of this lab

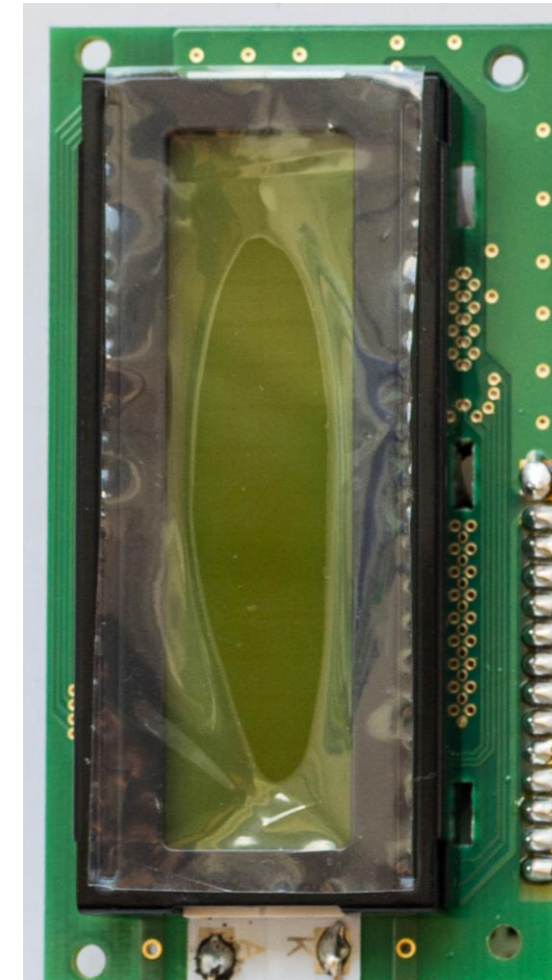
Push Switch to use



LCD Interfacing

- We are going to use the LCD in 4-bit mode
 - Only 4 data wires are required instead of 8
- LCD pin assignment is as follows:

No.	Symbol	Connections with ATmega328P
1, 3	V_{SS}, V_{EE}	GND
2	V_{CC}	5V
4	RS	PC4
5	R/W	GND (Always Write to LCD)
6	E	PC5
7-10	DB0-DB3	Not Connected
11-14	DB4-DB7	PC0-PC3



- Pin1: V_{SS} → GND
- Pin2: V_{CC} → 5V
- Pin3: V_{EE} → GND
- Pin4: RS → PC4
- Pin5: R/W → GND
- Pin6: E → PC5
- Pin7: DB0 → N/C
- Pin8: DB1 → N/C
- Pin9: DB2 → N/C
- Pin10: DB3 → N/C
- Pin11: DB4 → PC0
- Pin12: DB5 → PC1
- Pin13: DB6 → PC2
- Pin14: DB7 → PC3

- Pin16: ANODE → 5V
- Pin15: CATHODE → GND

LCD Test Program

```
// ----- Preamble ----- //
#define F_CPU 16000000UL /* Tells the Clock Freq to the Compiler. */
#include <avr/io.h> /* Defines pins, ports etc. */
#include <util/delay.h> /* Functions to waste time */
#include "lcd_lib.h" /* LCD Library */

int main(void) {
    // ----- Inits ----- //
    initialize_LCD(); /* Initialize LCD */

    LcdDataWrite('A'); /* Print a few characters for test */
    LcdDataWrite('B');
    LcdDataWrite('C');

    // ----- Event loop ----- //
    while (1) {
        /* Nothing to do */
    } /* End event loop */
    return (0);
}
```

Task 1: Extending the Debounce State Machine & LED Frequency Toggling

- Extend the 3-State Debounce State Machine such that the transition from the state **Pushed** → **Maybe** → **Pushed** is not considered a new button push
 - This eliminates the possible errors of the 3-State Debounce State Machine
- Use this extended debounce state machine to toggle the LED blinking frequency (Lab2b: Task1) using the switch
 - Each button push should toggle the LED blinking frequency between 2Hz and 8Hz. (So, no matter the duration of the button push, a single button push should toggle the frequency only once.)
 - Also print the frequency of the current mode on LCD

Task 2: Non-Blocking UART Reads

- Modify the LED frequency switching task (Lab2b: Task3) such that the UART reads are non-blocking. In other words, the LED should keep blinking when the user is asked if he wants to change the LED frequency.
 - Use UART interrupt service routine to receive the characters in a buffer (as shown in the lecture)
- Implement Task_InterpretReadBuffer() function to:
 - Properly handle the frequency switching
 - Display the current frequency on LCD