Smart Traffic Light

short line

# **Document Info**

## Challenge ID: 12

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## Reviewer Name: Sherif

## Document seen by: Instructor, Reviewer and Students

# **Learning objectives**

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| **Objective (Technical or Non-Technical)** | **Covered by Challenge** | **Covered by Capsule** |
| Embedded C | **✓** |  |
| Function-Like Macro | **✓** | **✓** |
| Flashing Code to Microcontroller | **✓** |  |
| Volatile Modifier | **✓** | **✓** |
| Bitwise operations | **✓** | **✓** |
| Memory Mapped Registers | **✓** | **✓** |
| What is GPIO | **✓** | **✓** |
| GPIO Current and Power |  | **✓** |
| GPIO Ports | **✓** |  |
| Data Direction Register | **✓** |  |
| Data Register | **✓** |  |
| Input Register | **✓** |  |
| What is Timer |  | **✓** |
| Timer Frequency | **✓** |  |
| Using Prescaler | **✓** | **✓** |
| Tradeoff between duration and resolution | **✓** | **✓** |
| Timer Frequency | **✓** |  |
| Timer modes | **✓** | **✓** |
| Normal Mode | **✓** | **✓** |
| CTC | **✓** | **✓** |
| LED | **✓** |  |
| Switch | **✓** |  |

# **Challenge**

# Sprint number (1)

## User story (1): (5 Points)

Make a .h file that defines standard types, uint8, uint16, sint8, sint32.,uint8\*.etc

## User story (2): (10 Points)

Use the file created in Story(1) to make another .h file that defines 4 Function-like macros, Set\_Bit(Register,Bit) , Clear\_Bit(Register,Bit), Get\_Bit(Register,Bit), Toggle\_Bit(Register,Bit).

All of which can operate on uint8 variable.

## User story (3): (5 Points)

Install all tools and drivers necessary for flashing your code on the ATMega microcontroller, then flash a code that lights a LED on the ECU indefinitely.

## User story (4): (20 Points)

Create new .c and its .h file to define a software(Non timer peripheral) delay function delay(uint32 n); , n resembles n milliseconds where the processor is blocked.

Then define a .h and .c files that define the Memory Mapped register using Macros e.g.

#define PORTA <Memory Address>

And define the following APIs

void DIO\_WritePin(uint8 PinNum,uint8 PinValue);

uint8 DIO\_ReadPin(uint8 PinNum);

void DIO\_SetPinDirection(uint8 PinNum,uint8 PinDirection);

Note Serialize the pins in all ports e.g.

Pin 0 in PortA is Pin0

Pin 0 in PortB is Pin8

## User story (5):(10 Points)

Use the previous to make an application that when a button 1 is pressed, LED 1 lights and stay lit for 1 second then the LED is switched off, if the buttons is kept pushed, the LED will stay lit, until 1 second has passed while the button was not pushed.

## User story (6): (25 Points)

Using LED 1, 2 and 3 assume that LED 1 means go, LED 2 means get ready, LED 3 Means stop

Make a periodic state machine that changes with time (1 second) with no external input.

The state machine:

GO->Stop->Get Ready->Go.

## User story (7): (25 Points)

Make .c and .h files for the Timer peripheral in your microcontroller, the files should contain definitions for all the memory mapped registers, then make a

timer\_delay(uint32 n);

function that takes n milliseconds and during this time polls on OCR0 bit in TIFR register for the time passed, also make a basic INIT function that initializes your timer to the needed configurations.

timer\_init();

Then repeat story(6) using this new timer\_delay function.

## User story (8): (20 Bonus Points)

Add to the state machine applied in user story(7) that if button 1 is pressed, state is moved to state Stop and stays there for 1 second then continues the state machine from there.

With response time for the button no more than 50 milliseconds

Note: the time (1 second) counts only after the button is released

## Group members number (1, 2 or 4):

1

## SW/HW input environment:

Atmel Studio 7, eXtreme Burner and Avelabs Atmega Kit

## Test (If exists):

NA

## Restrictions (peripherals, configurations, what to use and not to use):

No Internet Connection

Required to deliver all files, for Story 6 and 7, and demonstrate the system working in both cases with similar behaviour.

Story 8 is bonus.