

Hardware Software Platforms Project Presentation

Distance Detection

Abrassart Theo & Hubert Louis
Theo.Abrassart@student.umons.ac.be
Louis.Hubert@student.umons.ac.be



Project presentation

Four main parts :

- Sensor presentation with tools
- I2C
- Unit tests
- Application

Project presentation

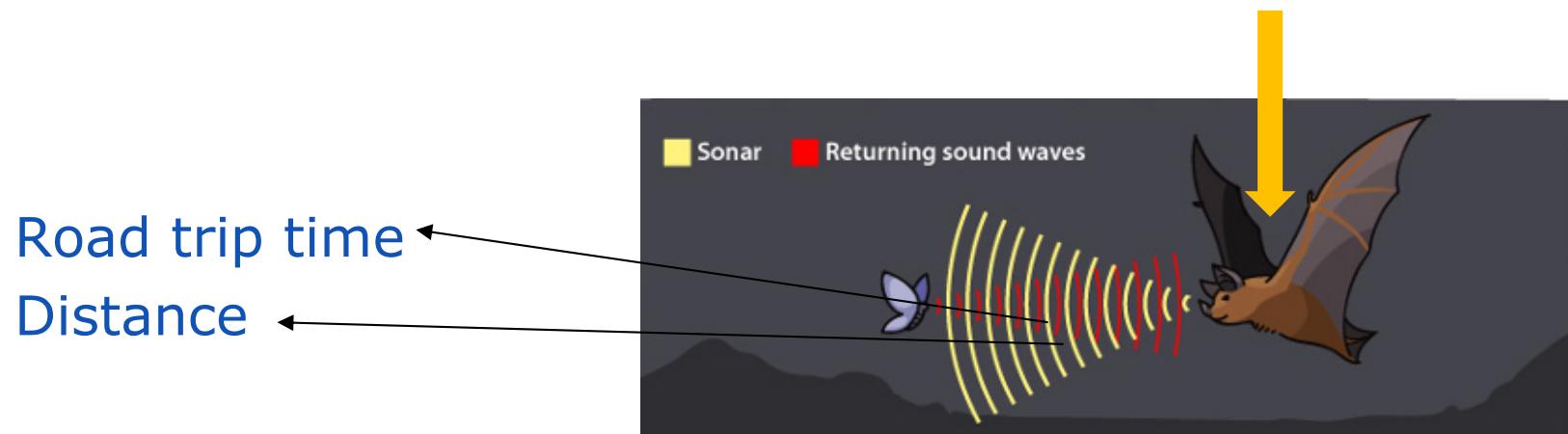
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Sensor presentation with tools

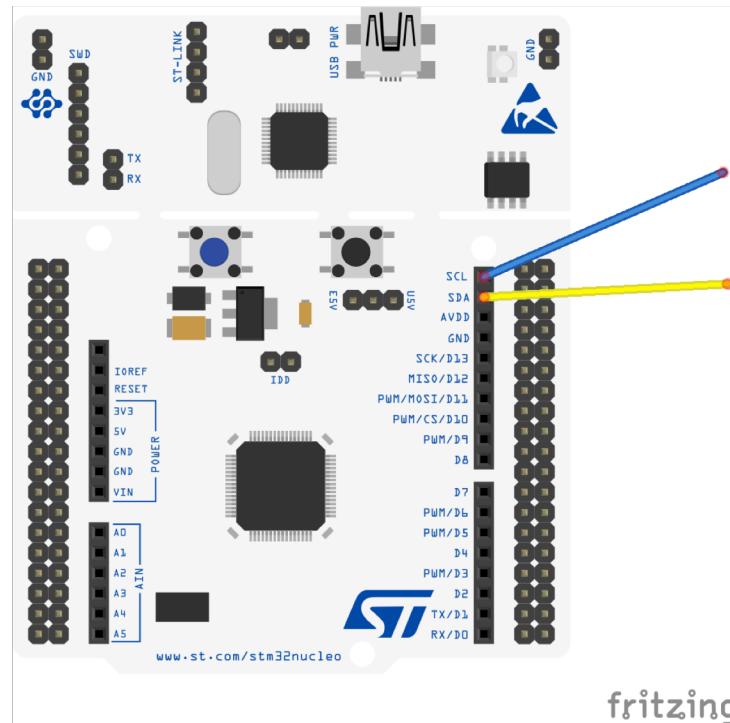
Hardware : Sonar sensor (SRF02)

- I2C communication
- Driven by STM32



Chip presentation

Hardware : STM32F303RE nucleo 64 chip



Software presentation

- **AC6 :**

Complete and useful environment

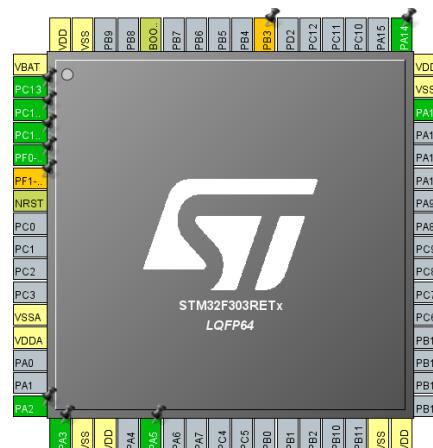
Allows to compile and put code on chip



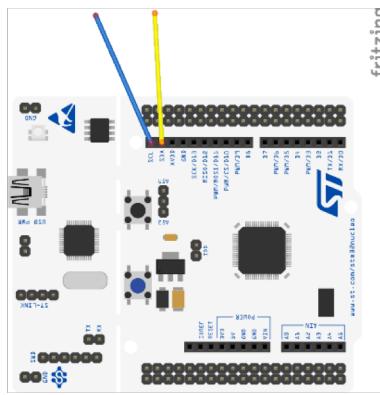
- **CubeMX :**

Chip selection and pins configuration

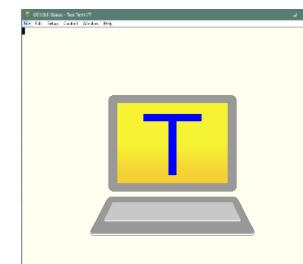
Code creation to set the drivers



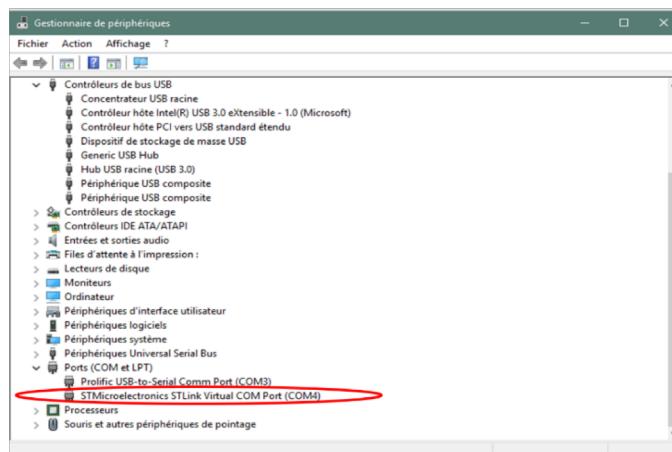
Hardware Software link



UART com.



Visualization of the com.



Don't forget to
select good port

Project presentation

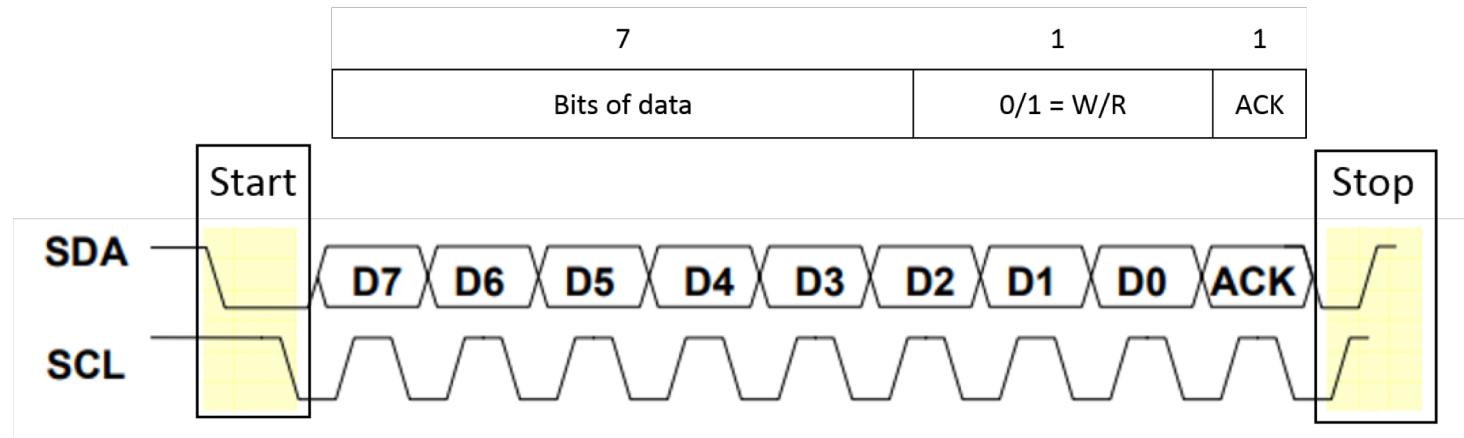
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Communication protocol I2C

3 signals → SDA/SCL/Bulk

Data frame :



Start condition : SDA passes to 0 while SCL is equal to 1

Stop condition : SDA passes to 1 while SCL stays at 1

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Unit tests : LED and button

Driving LED with switch case Using the button



```
while (1)
{
    /* USER CODE END WHILE */
    if(!HAL_GPIO_ReadPin(GPIOC, GPIO_PIN_13)) {
        choix = ((choix+1)%3);
        HAL_Delay(10);
    }

    switch (choix){

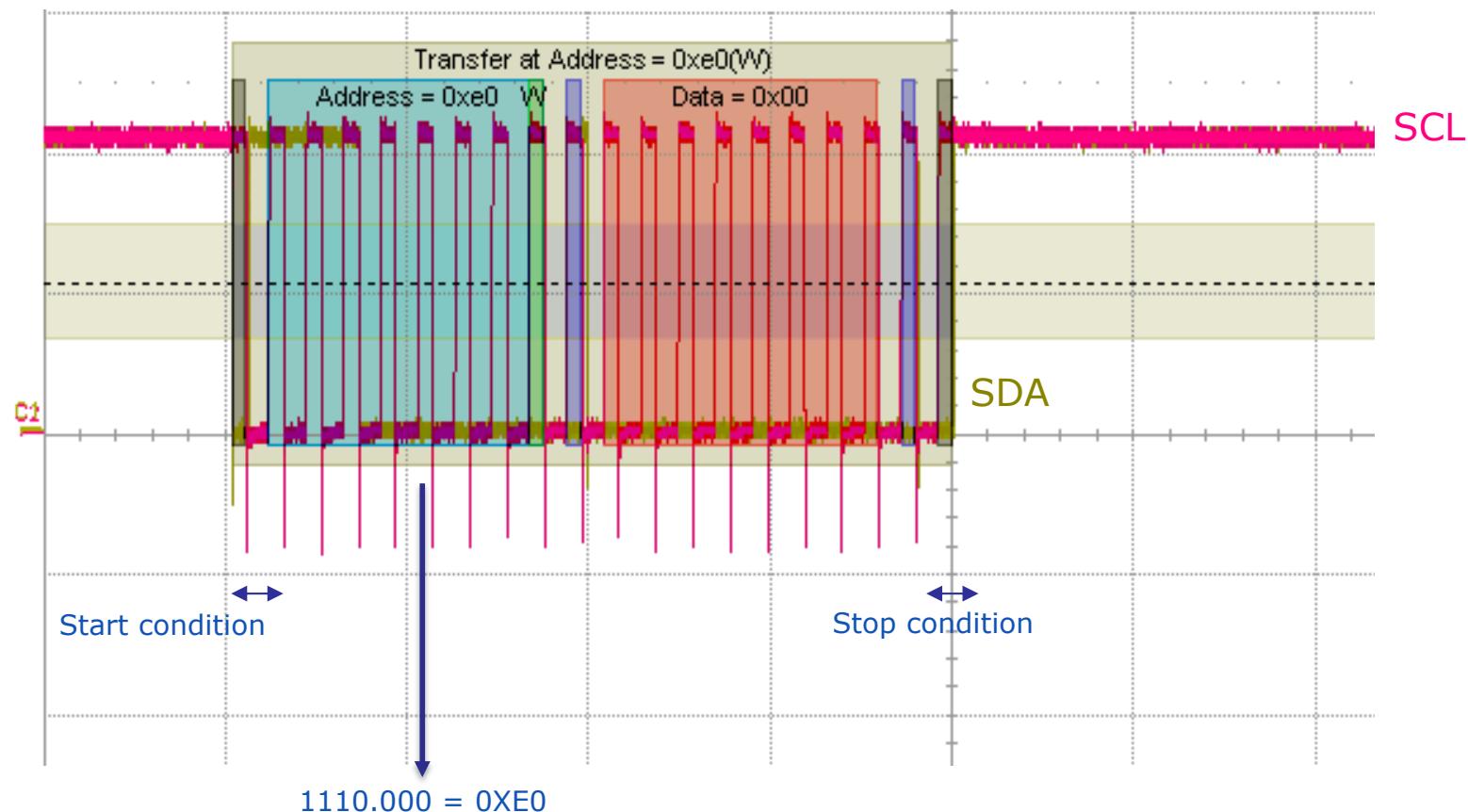
        case 0 :
            HAL_GPIO_WritePin(LD2_GPIO_Port, LD2_Pin, 0);
            HAL_Delay(250);
            HAL_GPIO_WritePin(GPIOA, GPIO_PIN_5, 1);
            HAL_Delay(250);
            break;

        case 1 :
            HAL_GPIO_WritePin(LD2_GPIO_Port, LD2_Pin, !HAL_GPIO_ReadPin(LD2_GPIO_Port, LD2_Pin));
            HAL_Delay(500);
            break;

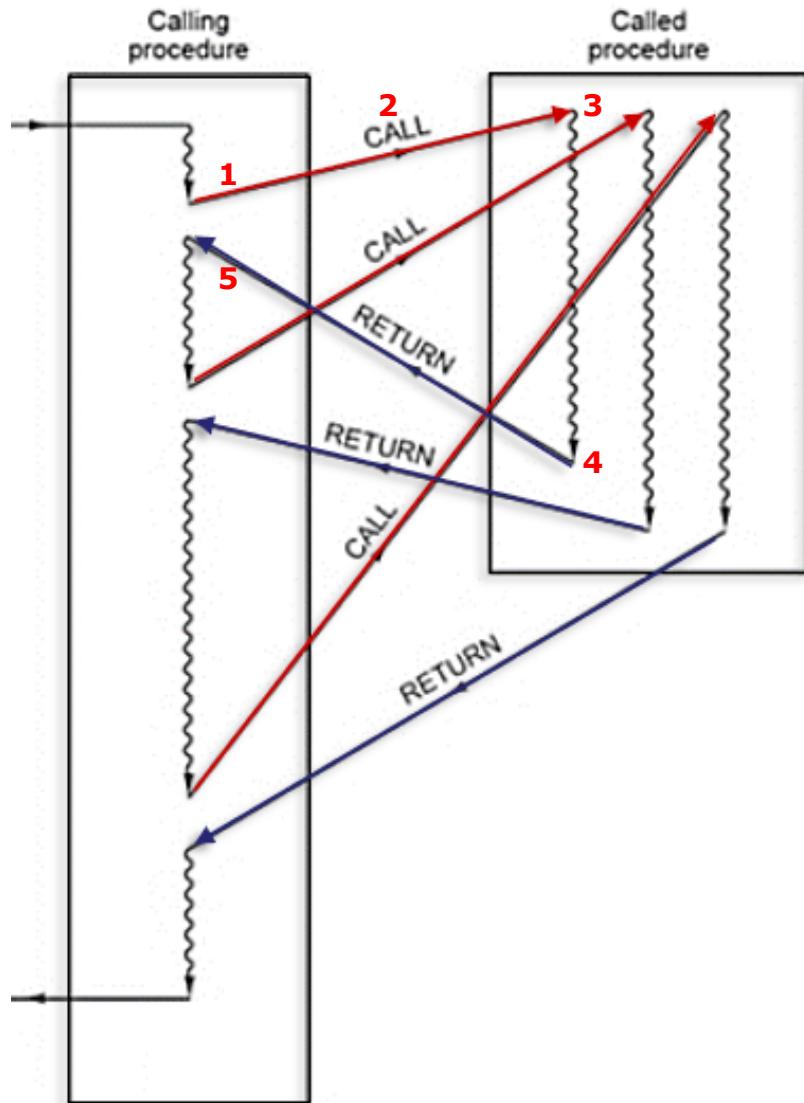
        case 2 :
            HAL_GPIO_TogglePin(LD2_GPIO_Port, LD2_Pin);
            HAL_Delay(50);
            break;
    }
}
```

Unit tests: I2C

Test transmission and reception of sequences



Unit tests : interrupt



1. - detection of the triggering event
- end of the current instruction
- ident. of the event occurred
- saving the address of current instruction in a stack
2. traversal to the interrupt processing routine
3. treatment of the corresponding interrupt
4. retrieving the return address
5. Return to the initial program

Sensor's datasheet

Location	Read	Write
0	Software Revision	Command Register
1	Unused (reads 0x80)	N/A
2	Range High Byte	N/A
3	Range Low Byte	N/A
4	Autotune Minimum - High Byte	N/A
5	Autotune Minimum - Low Byte	N/A

LSB register (8bits)

MSB register (8bits)

Information : 16 bits

→ Concatenation of MSB and LSB registers



Different commands of the sensor

Command		Action
Decimal	Hex	
80	0x50	Real Ranging Mode - Result in inches
81	0x51	Real Ranging Mode - Result in centimeters
82	0x52	Real Ranging Mode - Result in micro-seconds
86	0x56	Fake Ranging Mode - Result in inches
87	0x57	Fake Ranging Mode - Result in centimeters
88	0x58	Fake Ranging Mode - Result in micro-seconds
92	0x5C	Transmit an 8 cycle 40khz burst - no ranging takes place
96	0x60	Force Autotune Restart - same as power-up. You can ignore this command.
160	0xA0	1st in sequence to change I2C address
165	0xA5	3rd in sequence to change I2C address
170	0xAA	2nd in sequence to change I2C address

Here are the different commands to put in the CR

UART communication :



Enable the UART com. with STM32

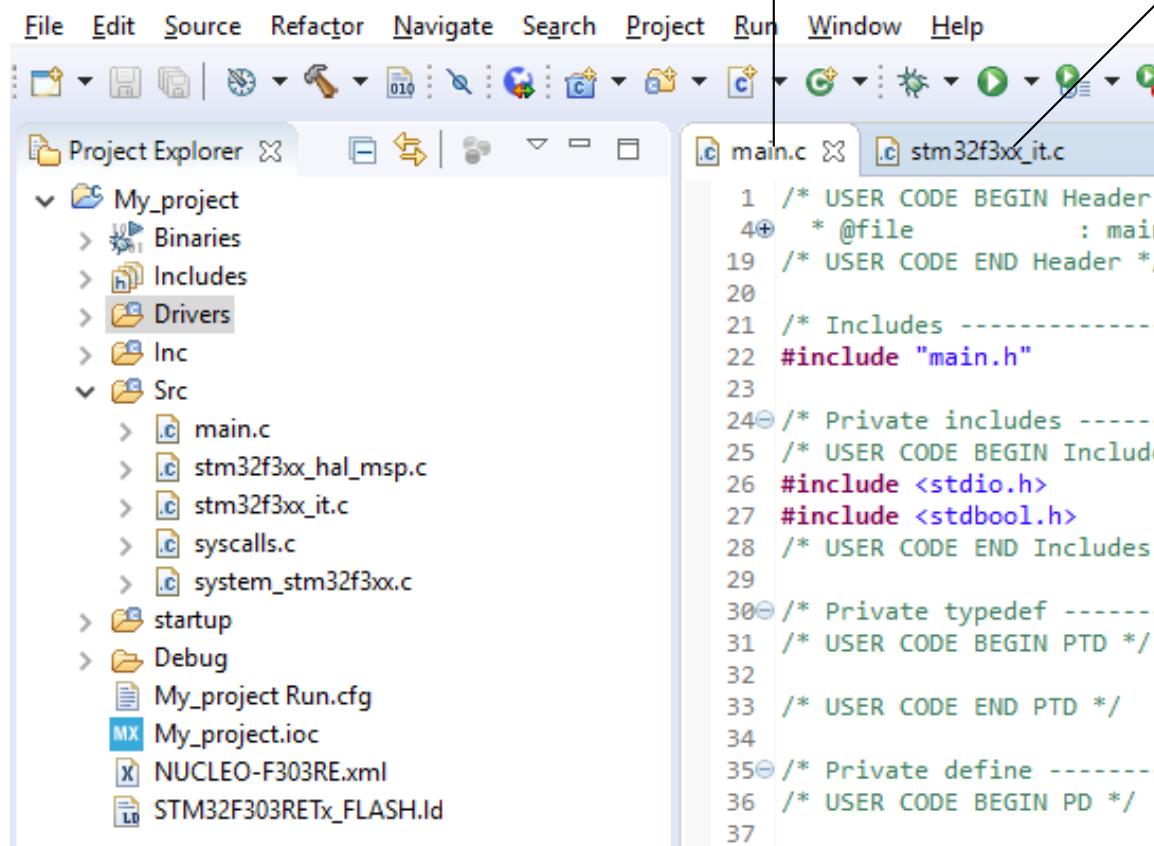
```
#ifdef __GNUC__
#define PUTCHAR_PROTOTYPE int __io_putchar(int ch)
#else
#define PUTCHAR_PROTOTYPE int fputc(int ch, FILE *f)
#endif

PUTCHAR_PROTOTYPE{
    HAL_UART_Transmit(&huart2, (uint8_t *)&ch, 1, 100);
    return ch;
}
```

Software implementation

FSM management

Interrupt management



The screenshot shows the STM32CubeIDE interface. The Project Explorer on the left displays a project structure for 'My_project' with folders like Binaries, Includes, Drivers, Inc, and Src containing files such as main.c, stm32f3xx_hal_msp.c, stm32f3xx_it.c, syscalls.c, and system_stm32f3xx.c. The main window shows two tabs open: 'main.c' and 'stm32f3xx_it.c'. The 'main.c' tab is active, displaying C code with line numbers 1 through 37. The code includes standard headers like stdio.h and stdbool.h, and defines for PTD and PD.

```
1 /* USER CODE BEGIN Header
4 * @file      : main
19 /* USER CODE END Header */
20
21 /* Includes -----
22 #include "main.h"
23
24/* Private includes -----
25 /* USER CODE BEGIN Include
26 #include <stdio.h>
27 #include <stdbool.h>
28 /* USER CODE END Includes
29
30/* Private typedef -----
31 /* USER CODE BEGIN PTD */
32
33 /* USER CODE END PTD */
34
35/* Private define -----
36 /* USER CODE BEGIN PD */
```

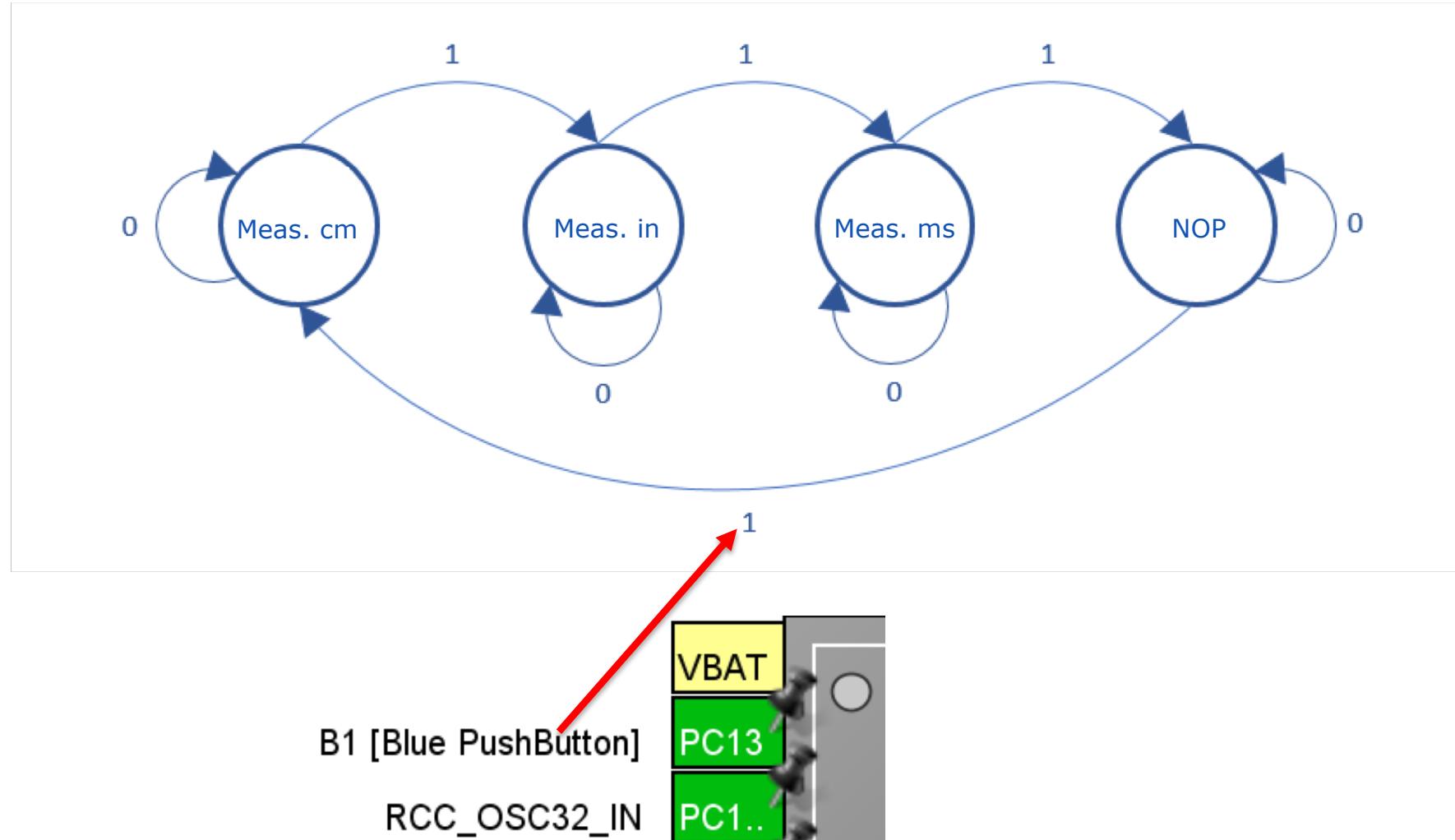
Modification of C
code on AC6

Project presentation

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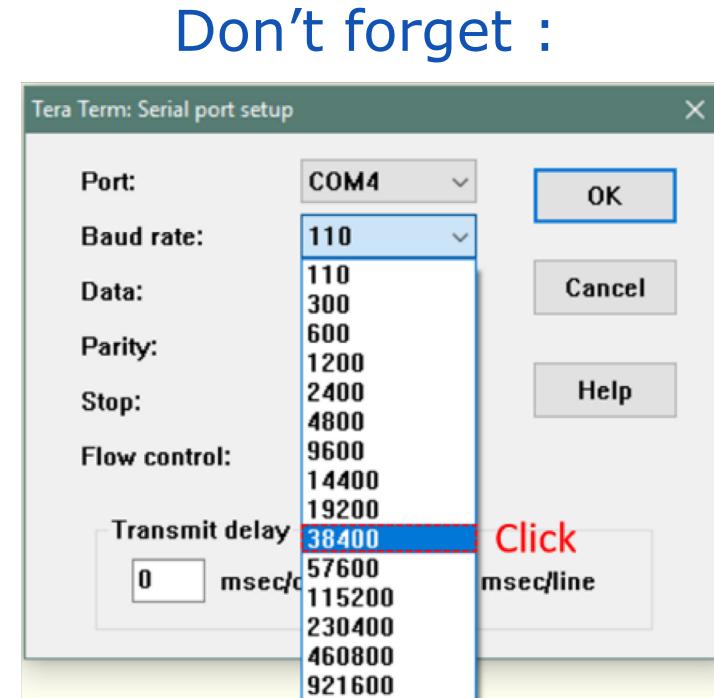
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Application : Finite State Machine



Final results :

```
COM4:38400baud - Tera Term VT
File Edit Setup Control Window Help
La distance vaut : 347 cm
Nous sommes dans le case 0
La distance vaut : 347 cm
Nous sommes dans le case 1
La distance vaut : 136 pouces
Nous sommes dans le case 2
Le temps vaut : 20 ms
Nous sommes dans le case 3
```



Video : hardware and software

<https://www.youtube.com/watch?v=smweBf85Wjg&feature=youtu.be&fbclid=IwAR36StgGNxwbV-TLYLgbpehZIk4X9RS3St-fv-t5zZuzoIZ4vy58R3xnsk>

Acknowledgement

We would like to thank Mr. Valderrama, Mr. Binon and Mr. Quenon for their help in this project and their valuable pieces of advice.

Bibliography

- <https://robot-electronics.co.uk/srf02.html>; (SRF02)
- <https://chauve-souris.ca/tout-savoir-sur-les-chauves-souris>; (bat)
- <https://www.jaycar.com.au/white-5mm-led-4000mcd-round-clear/p/ZD0190>; (LED)
- https://www.robot-italy.com/download/srf02_i2c.pdf; (Datasheet)
- <https://moodle.umons.ac.be/mod/resource/view.php?id=7403> (Interrupt)
- <https://french.alibaba.com/product-detail/volume-control-adjustable-potentiometer-knob-switch-rotary-angle-sensor-for-arduino-avr-stm32-60294805563.html>. (button)