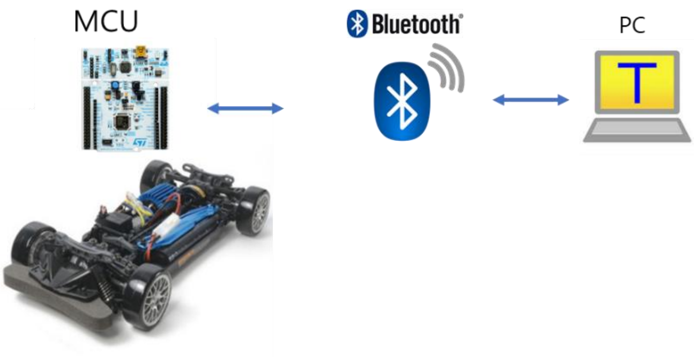
Design Problem: RC Car Control with Bluetooth

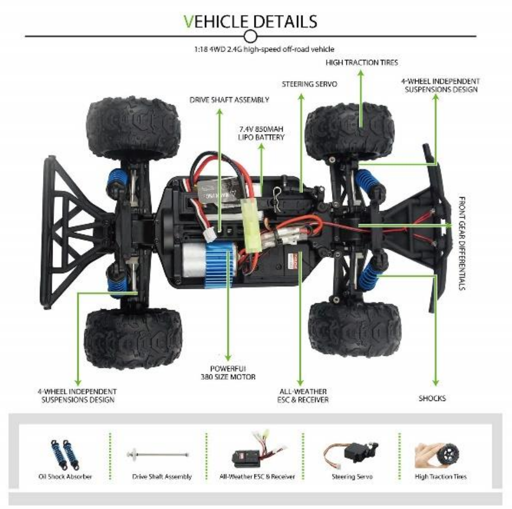
I. Introduction

Design a simple program to control an RC car steering and speed by sending the command message from PC via bluetooth.

Motor 1: RC servo – for Steering (LEFT or RIGHT)

Motor 2: DC motor– for Speed and Heading Direction (FWD or BWD)





Hardware

NUCLEO -F411RE, Bluetooth Module(HC-06), breadboard, DC motor, DC motor driver(L9110s), LEDs x 3, Resistor 330 ohm x 3, breadboard, RC Servo Motor (SG90)

Software

Keil uVision IDE, CMSIS, EC_HAL

II. Problem

Create a program to control two DC motors by giving a command from PC using Bluetooth module. The program should perform the following tasks by the user keyboard input. You must use appropriate interrupts

Print the status every 1 sec such as " ("RC car: DIR: 00[deg] VEL: 00[%] FWD")

Steering: RC Servo (Motor 1)

- Divide 180° into 4 intervals.
- Intially start the angle of RC servor motor at 90°.
- Steering cotrol with keyboard key. Increase or decrease the angle of RC servor motor by 45° each time you push the arrow key "RIGHT" or "LEFT", respecively.

Speed: DC motor (Motor 2)

- Intially configure the duty ratio of DC motor at "0%"
- Increase or decrease the speed by 25% duty each time you push the arrow key "UP" or "DOWN", respecively.
- The RC car driving direction should be forward or backward by pressing the key "F" or "B", respecively.
- The RC car must stop running whe the key "S" is pressed.
- Apply PWM to (A-IA) of motor driver
- Apply Direction (H or L) to (A-IB) of motor driver

Key	Task	Comment
UP	Motor Speed Increases	Increase PWM duty ratio by 25% for each press. Initial value : duty 0% The maxim duty value should be 100%.
DOWN	Motor Speed decreases	Decrease PWM duty ratio by 25% for each press The minimum duty value should be 0%.
LEFT	Left turn	Turn Left by 45degree
RIGHT	Right turn	Turn Right by 45degree
F	Forward direction	Go forward. Default setting DIR=1
B	Backward direction	Reverse driving. DIR=0
S	Stop	Make duty=0% for both motors

B. Configuration

You are free to select appropriate configurations for the design problem. Fill in the table.

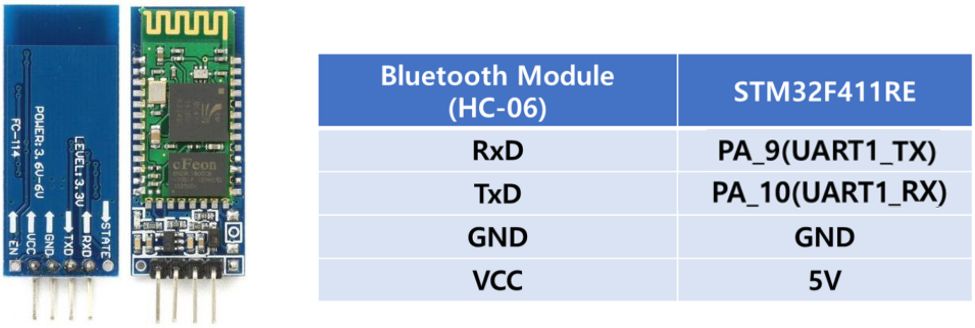
Functions	Register	PORT_PIN	Configuration
System Clock	RCC		PLL 84MHz
delay_ms	SysTick		
Motor DIR	Digital Out		
	….		
TIMER	TIMER1		
	TIMER2		
	TIMER3		
	….		
RC servo angle	PWM1		
DC Motor Speed	PWM2		
RS-232 USB cable(ST-LINK)	USART2		No Parity, 8-bit Data, 1-bit Stop bit 38400 baud-rate
Bluetooth	USART1	TXD: PA9 RXD: PA10	No Parity, 8-bit Data, 1-bit Stop bit 9600 baud-rate

III. Resources

A. Bluetooth Module

Search for the bluetooth module specification sheet (HC-06) and study the pin configurations. The default PIN number is 1234.

Example of connecting to USART1



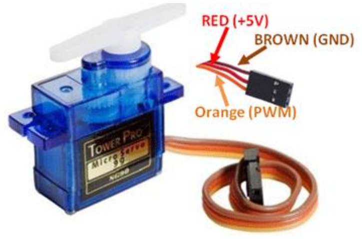
Bluetooth Module (HC-06)	STM32F411RE
RxD	PA_9(UART1_TX)
TxD	PA_10(UART1_RX)
GND	GND
VCC	5V

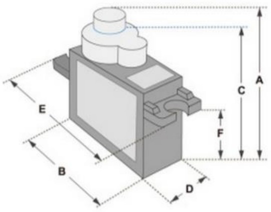
Figure 1. Connection of a bluetooth module

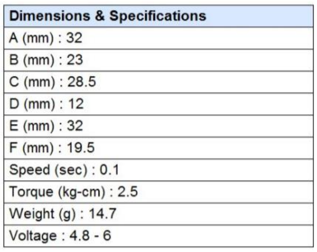
B. RC Servo motor: RC Servo Motor (SG90)

An RC servo motor is a tiny and light weight motor with high output power. It is used to control rotation angles, approximately 180 degrees (90 degrees in each direction) and commonly applied in RC car, and Small-scaled robots.

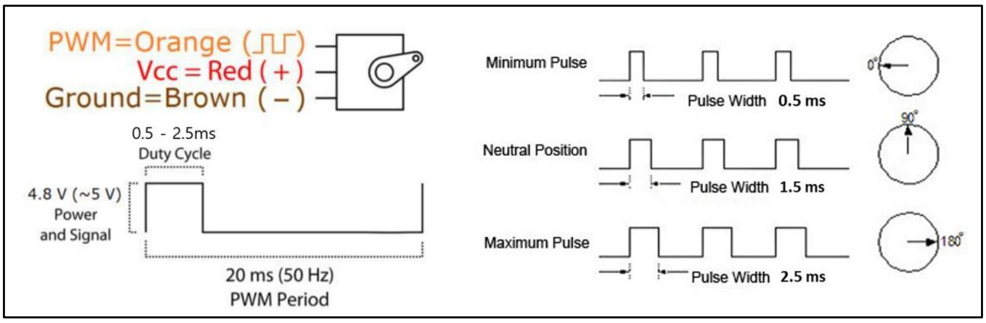
The angle of the motor can be controlled by the pulse width (duty ratio) of PWM signal. The PWM period should be set at **20ms or 50Hz**. Refer to the data sheet of the RC servo motor for detailed specifications.







Dimensions & Specifications
A (mm) : 32
B (mm) : 23
C (mm) : 28.5
D (mm) : 12
E (mm) : 32
F (mm) : 19.5
Speed (sec) : 0.1
Torque (kg-cm) : 2.5
Weight (g) : 14.7
Voltage : 4.8 - 6



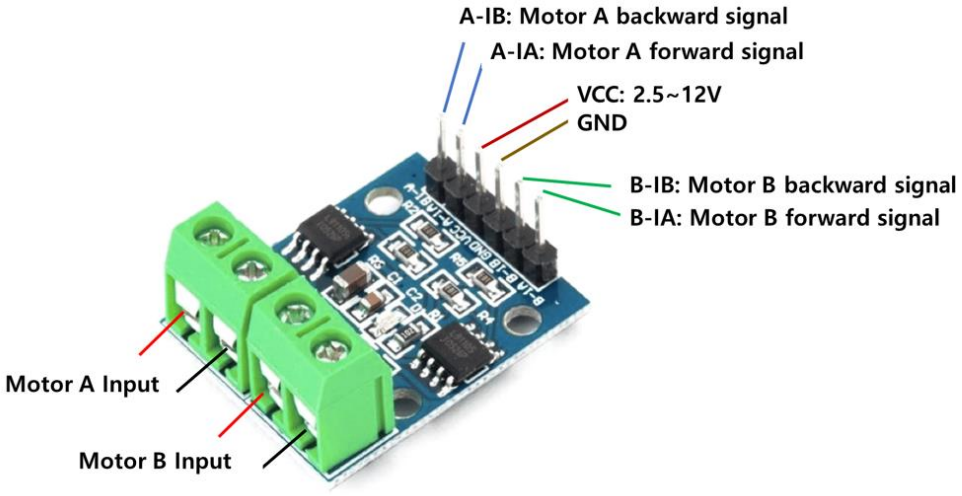
Operation of Servo Motor

C. DC Motor driver

Connect DC motor drive(L9110s) module pins to MCU as shown below.

DO NOT use MCU’s VCC to motor driver. You should use external voltage source.

- IA: PWM pin
- IB: Direction Pin (Digital Out H or L)


A-IB: Motor A backward signal
A-IA: Motor A forward signal
VCC: 2.5~12V
GND
B-IB: Motor B backward signal
B-IA: Motor B forward signal
Motor A Input
Motor B Input