Racing Game Data 분석과 탄성체 Actuator 제작을 통한 체감형 Racing Simulator 제작

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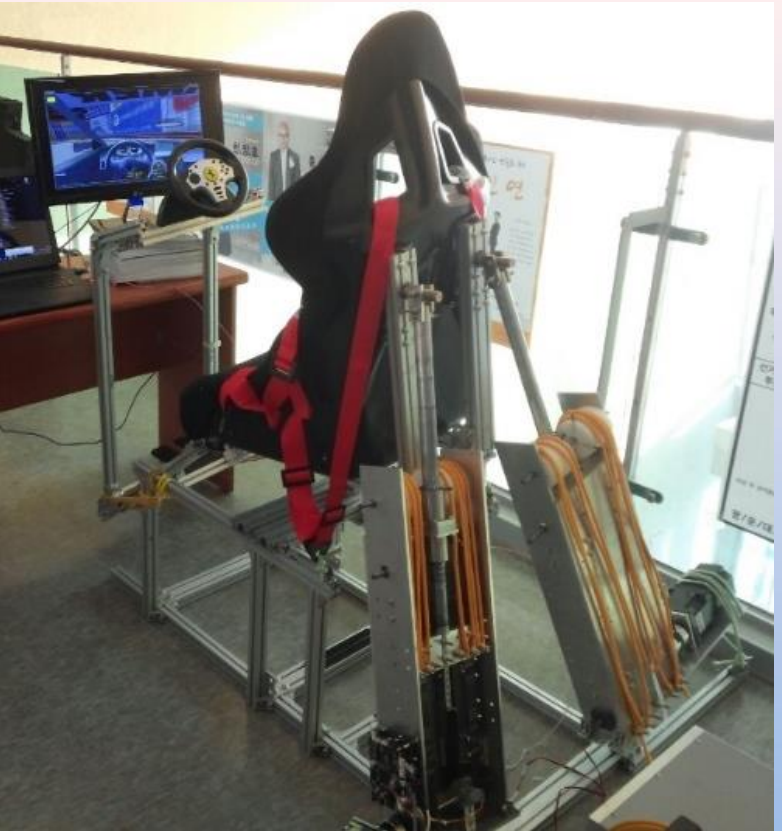
Texas Instruments

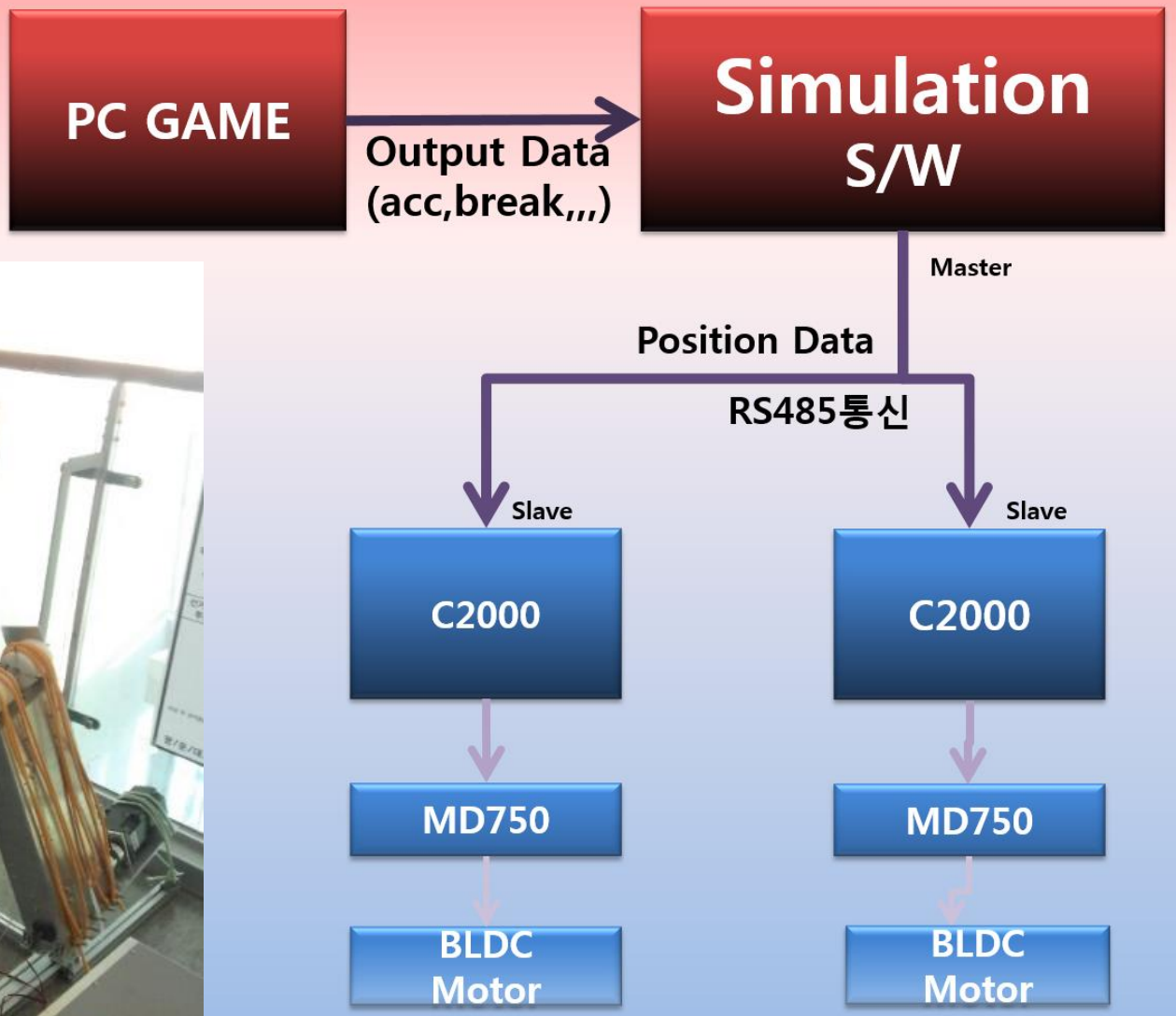
Racing Simulator

Development Motive

Racing Simulator

System Architecure





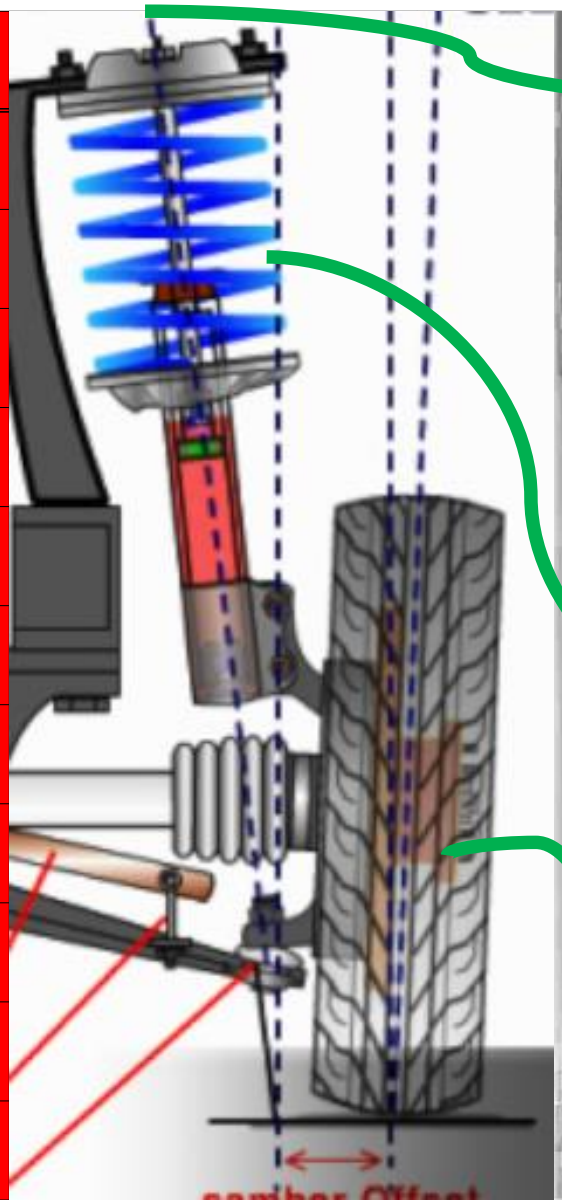
Racing Simulator

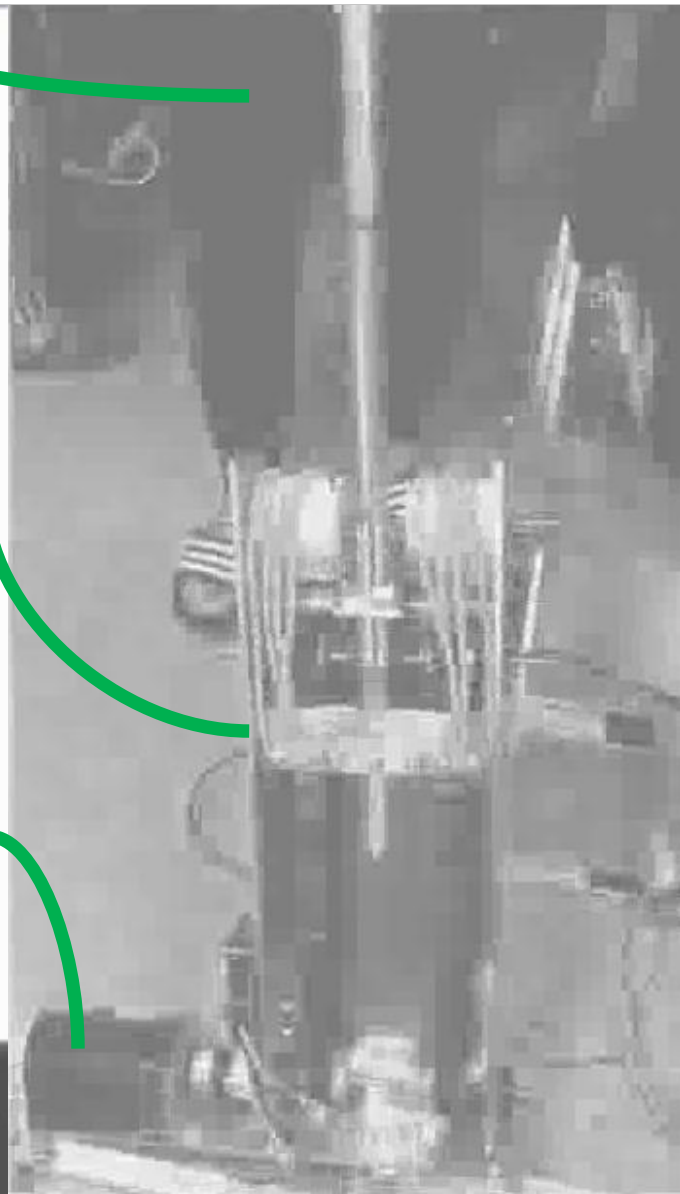
S/W - UI

Racing Simulator

H/W - Elastic Acutator

Actuator 방식	제작 – 2축 전기 타이밍벨트
단가	↓
속도	↑
Roll 정도	±30˚
Pitch 정도	±30˚
Yaw 정도	±10˚
질감 충격 정도	↑
가속도 정도	↑
게임 호완성	↑
단가	↓
안정성	↓





H/W - Racing Simulator

Racing Simulator

C2000 - Why?

Texas Instruments

Need 1 **Real time control ➡ Can do exact control**

Need 2 **Real time debugging ➡ Catch problem easily**

Need 3 **3 External Interrupt ➡ Can use BLDC motor**

MSP : EXP430FR5969, EXP430F5529LP…

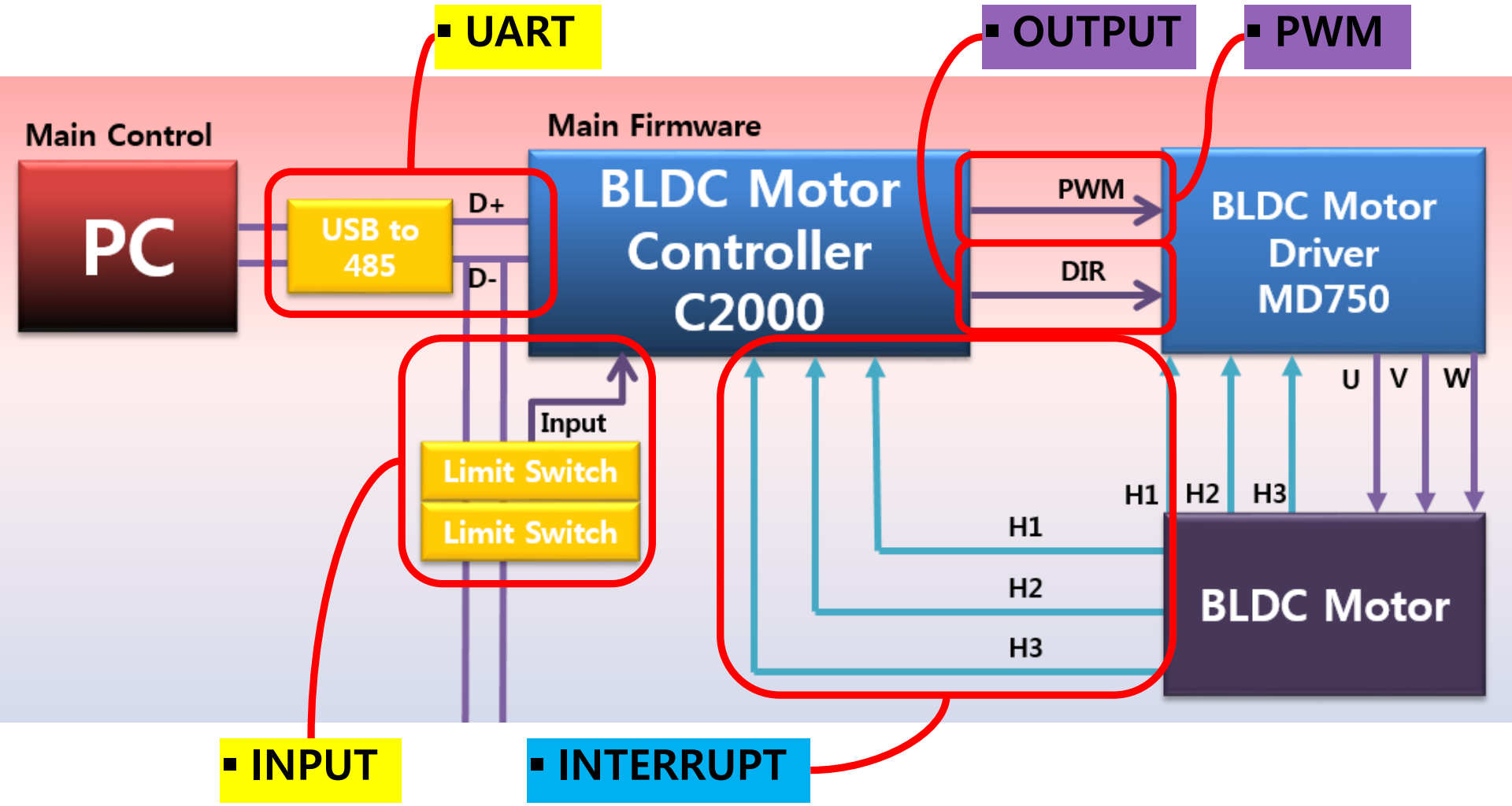
- Low-power, high performance
- Onboard emulator

TM4C : EK-TM4C123GXL

- Connectivity
- Two CAN modules
- 8 UART, 6 I2C, 4 SPI

Racing Simulator

C2000 - System Architecure

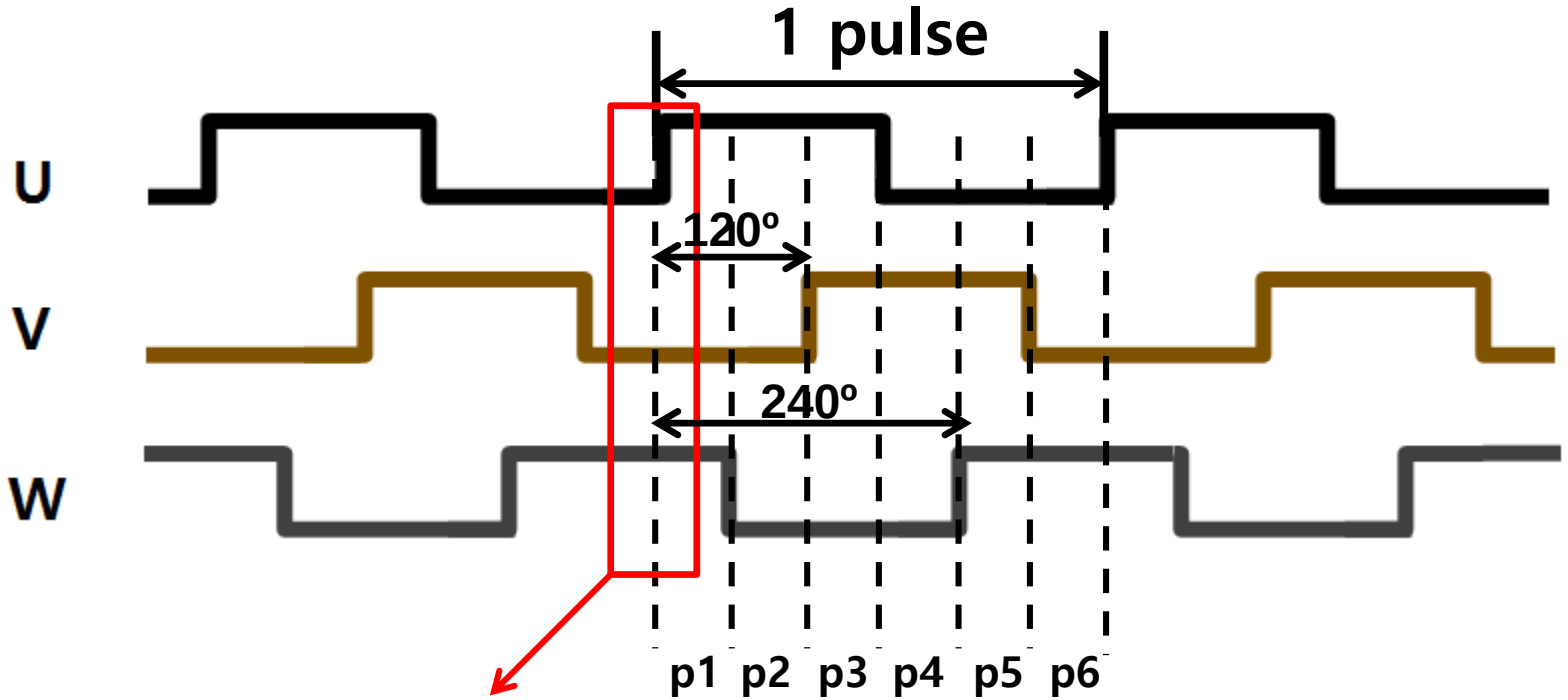


Racing Simulator

C2000 - Encoder (Interrupt)

C2000 - Motor PID Control (Timer)

- Hall sensor Resolution Multiplication (3-Phase)

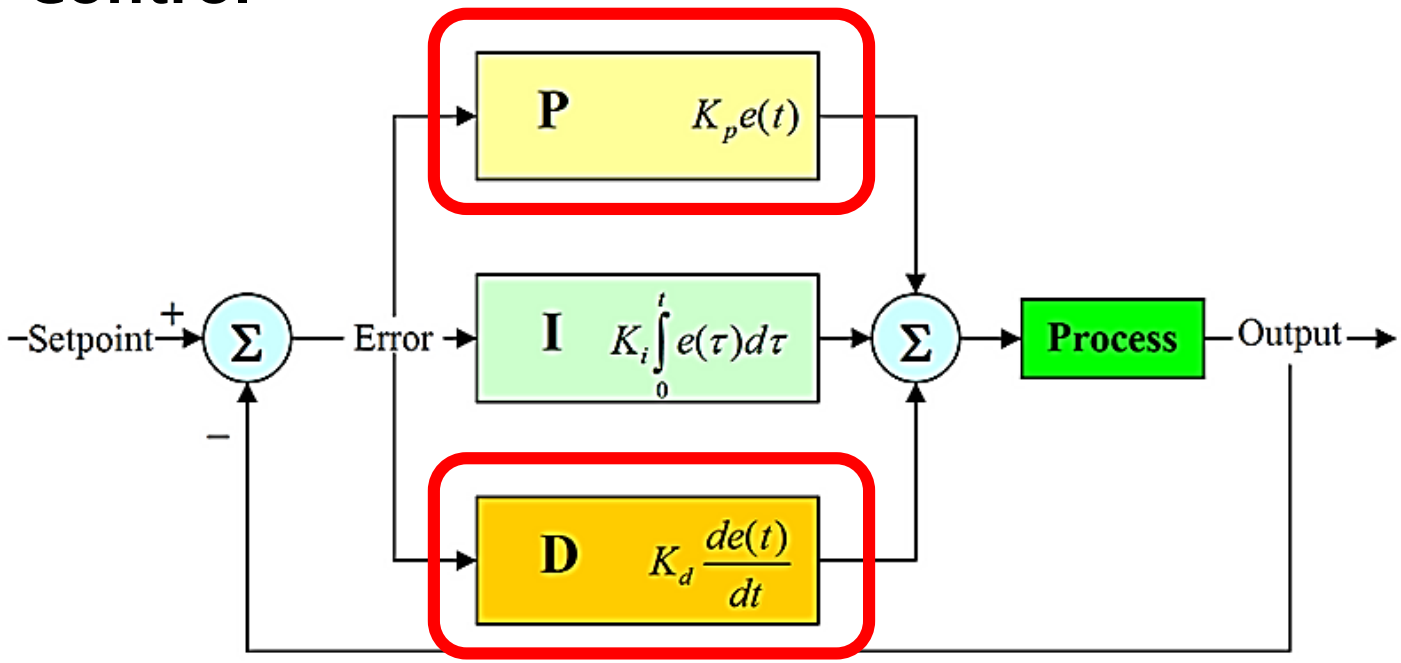


U ⟶ Rising Edge
V ⟶ Low
W ⟶ High

= 6 pulse (x6)

C2000 - Motor PID Control (Timer)

- Motor Position Control(BLDC Motor)
  - PD Control

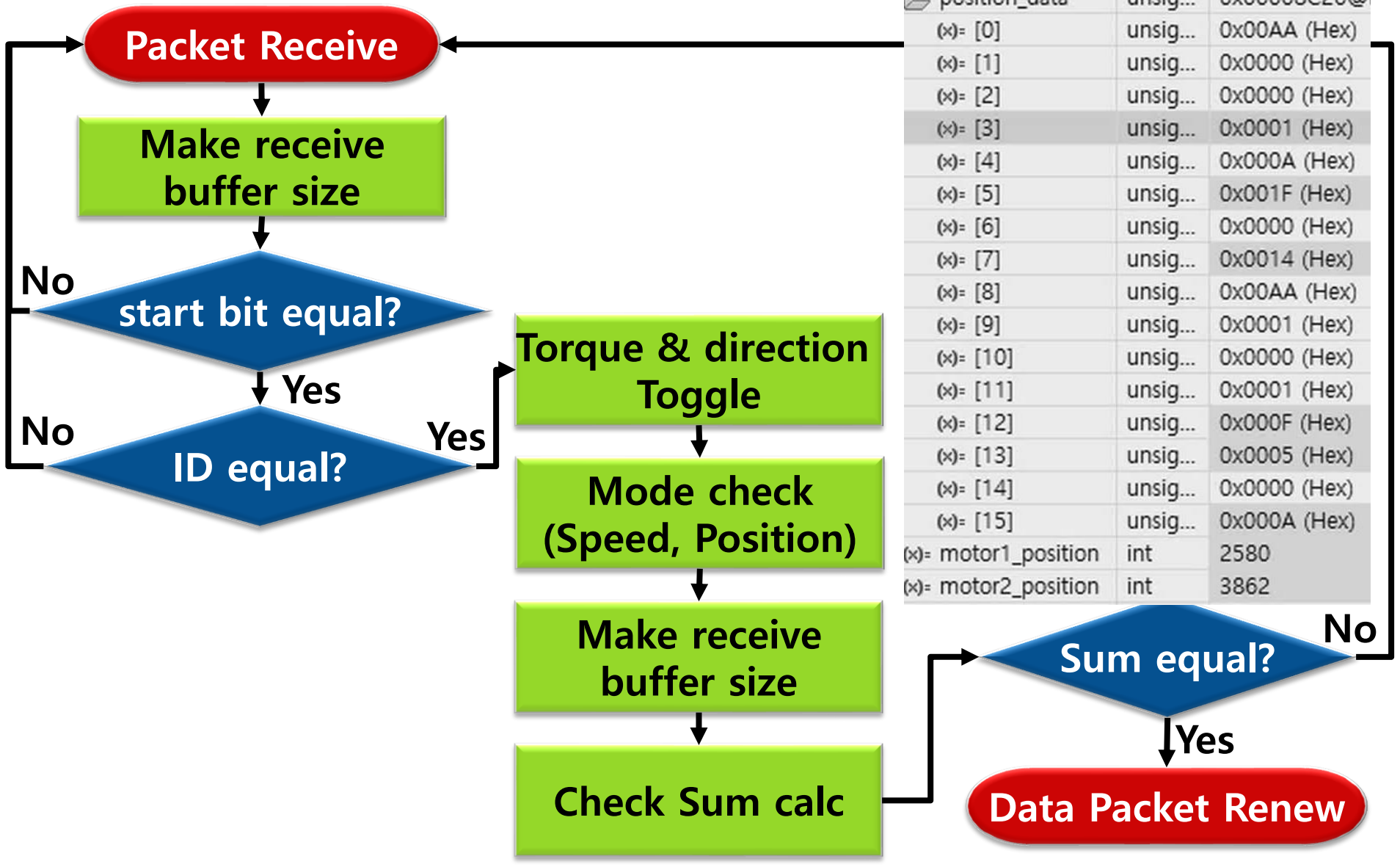


Set point : Hall Sensor Pulse

Output : PWM Pulse

Racing Simulator

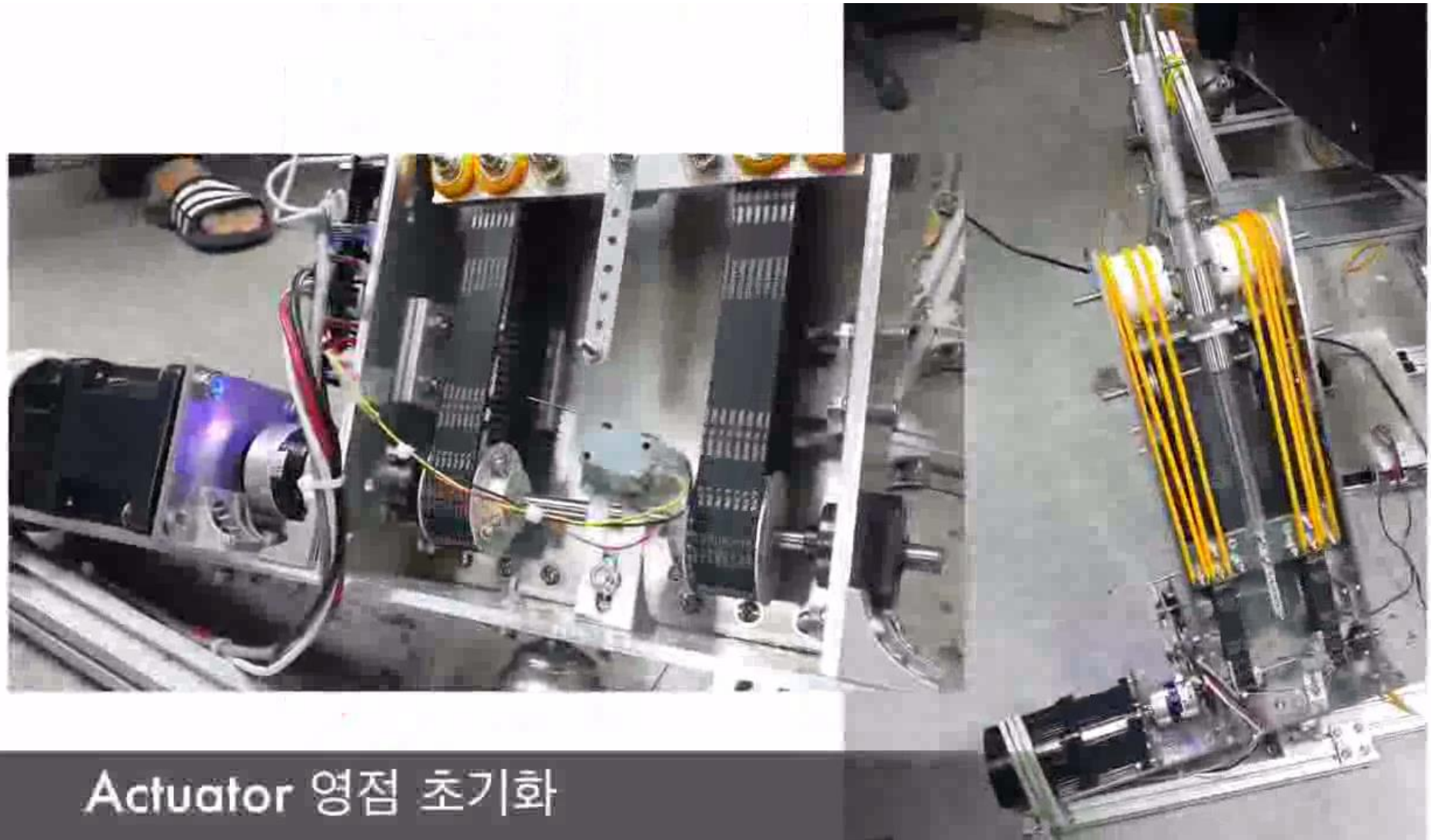
C2000 - Communication (UART)(PC to C2000)



position_data	unsig...	0x00008C26@
(x)= [0]	unsig...	0x00AA (Hex)
(x)= [1]	unsig...	0x0000 (Hex)
(x)= [2]	unsig...	0x0000 (Hex)
(x)= [3]	unsig...	0x0001 (Hex)
(x)= [4]	unsig...	0x000A (Hex)
(x)= [5]	unsig...	0x001F (Hex)
(x)= [6]	unsig...	0x0000 (Hex)
(x)= [7]	unsig...	0x0014 (Hex)
(x)= [8]	unsig...	0x00AA (Hex)
(x)= [9]	unsig...	0x0001 (Hex)
(x)= [10]	unsig...	0x0000 (Hex)
(x)= [11]	unsig...	0x0001 (Hex)
(x)= [12]	unsig...	0x000F (Hex)
(x)= [13]	unsig...	0x0005 (Hex)
(x)= [14]	unsig...	0x0000 (Hex)
(x)= [15]	unsig...	0x000A (Hex)
(x)= motor1_position	int	2580
(x)= motor2_position	int	3862

Racing Simulator

C2000 - Switch (Input)



Problem & Solution

- Hardware
  - Heavy weight actuator
    - Use elastic holding

- Control
  - Interrupt signal not clear
    - Change internal to external pull-up resistor

- Communication
  - Not perfectly receive whole packet
    - Make checksum and buffer size system

Q&A

Texas Instruments

Thank you