Xilinx Zynq FPGA, TI DSP, MCU 프로그래밍 및 회로 설계 전문가 과정

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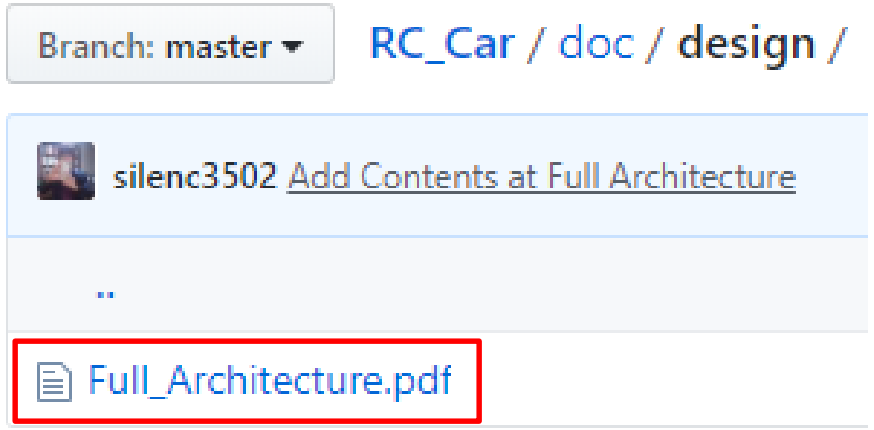
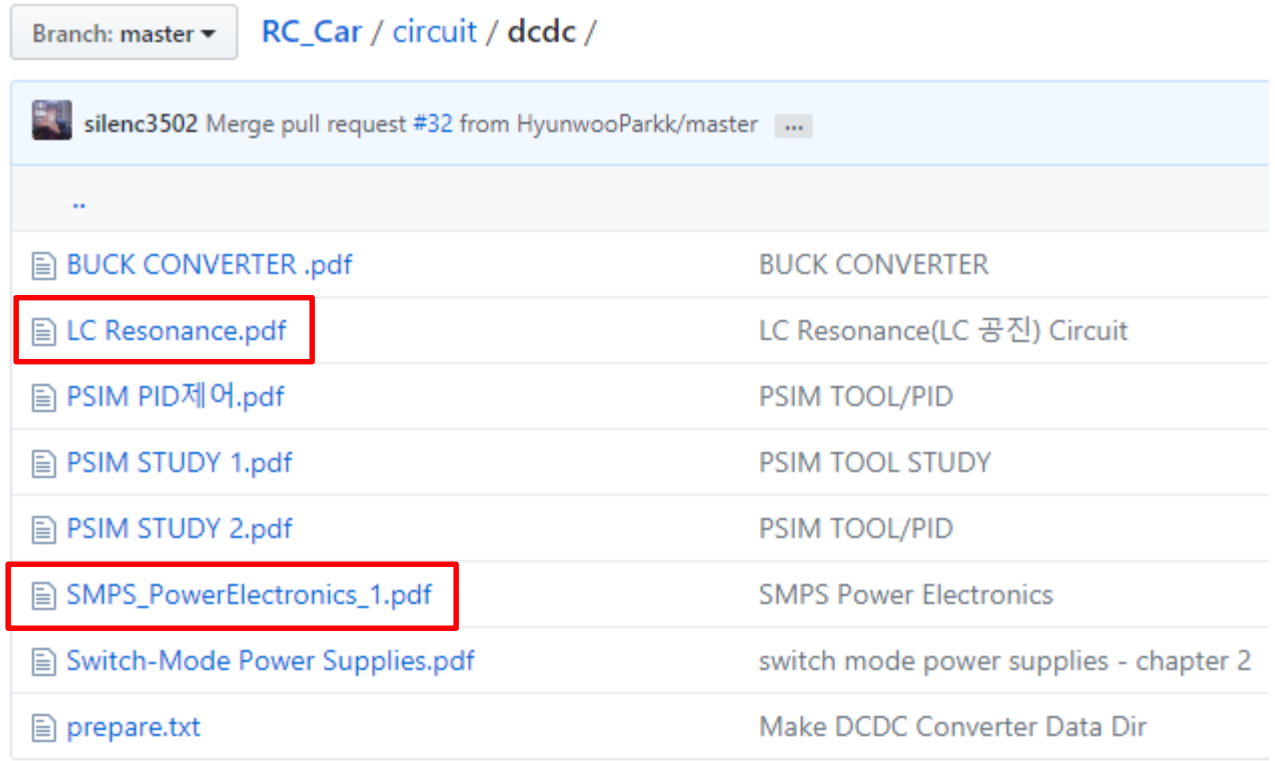
Current Mission Progress

전체 아키텍처에 대한 설계 문서



전체 구성에 대한 아키텍처를 이해하기 위해 만든 문서임
이 문서를 통해 본인이 뭘 해야 하는지 감을 잡길 바람

DC-DC 컨버터 개발과 관련한 작업들



향후 PCB 관련 정보는 PCB 디렉토리에 들어갈 것임

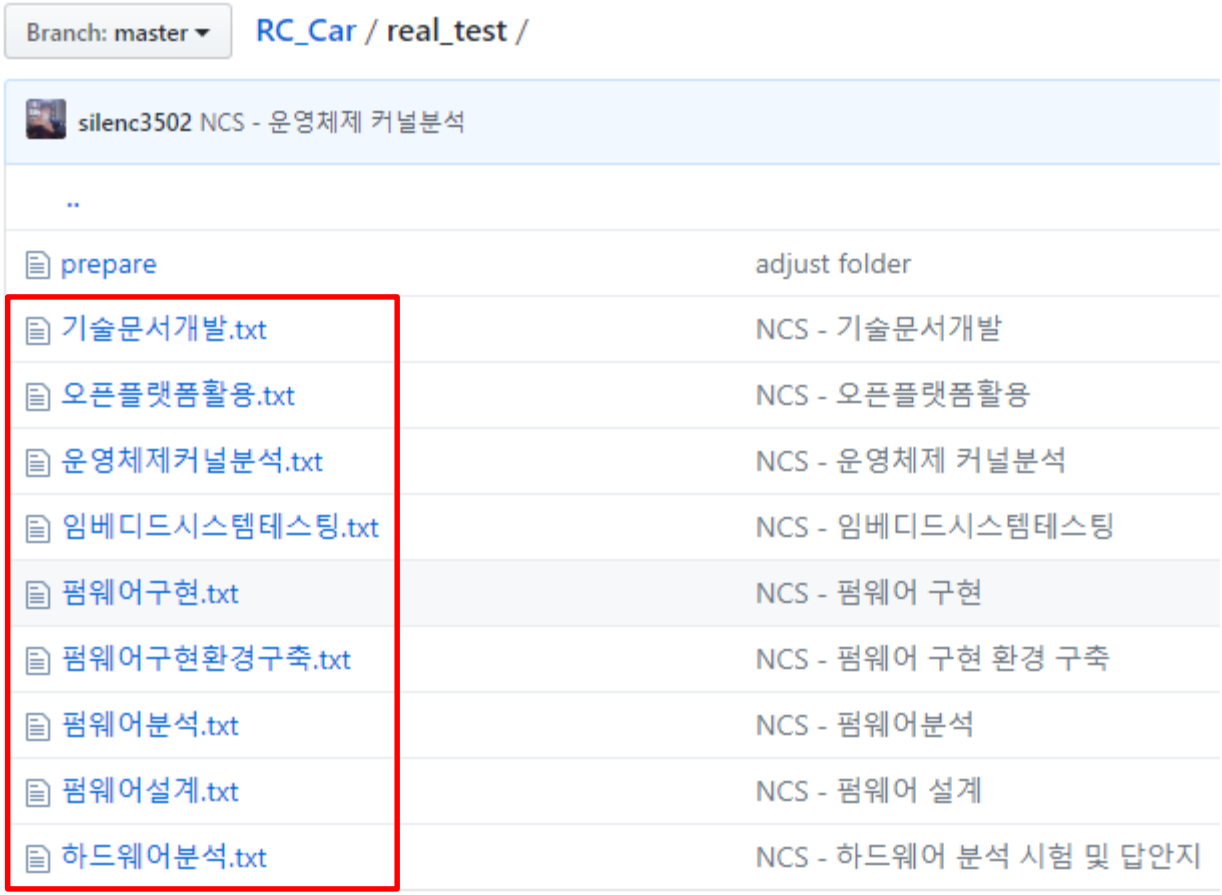
MCU, DSP, FPGA 관련 문서들

Branch: master ▾ RC_Car / experiment / doc /

silenc3502 FTDI USB2CAN

..	
esp8266	esp8266-esp-01 datasheet
AM5728_FTDI_USB_2_CAN.pdf	FTDI USB2CAN
AM5728_WiFi_Lab.pdf	AM5728 Based Wi-Fi Lab
Ardu_Based_ESP8266.pdf	Arduino Based Wi-Fi Module(ESP8266) Test
CAN_Test.pdf	Dedicated Doc for Experiment
Configuring CAN TMS570.txt	Dedicated Doc for Experiment
Cortex_R5_I2C_Howto.pdf	Cortex-R5F I2C Howto
DSP CAN(using_Serial_communication).pdf	How to use CAN2USB module in DSP
FreeRTOS_Guide.pdf	FreeRTOS manual
HET_PWM.pdf	HET Based PWM
Pmod_CAN_Control_with_Zybo.pdf	Pmod CAN Control with Zybo
RTI_GPIO_OC_Config.pdf	RTI Based Common Emitter Circuit
SPI_Comm.pdf	SPI Communication
SPI_Loopback.pdf	SPI Lookback Exam
stepmoter_test.pdf	How to work step motor in MCU
uart_test.pdf	Dedicated Doc for Experiment

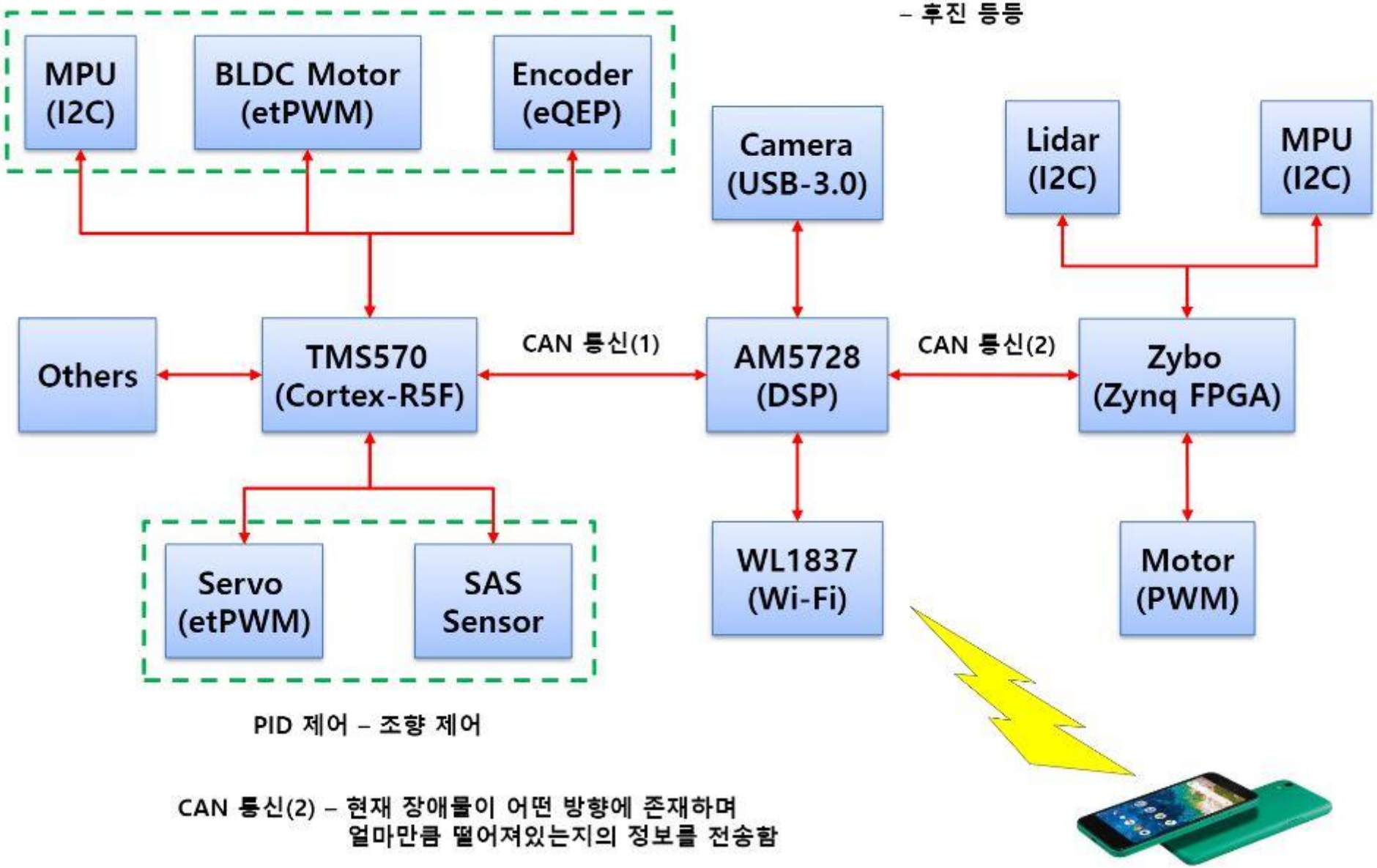
공공기관에서 나오시는 분들을 상대하기 위해 반드시 만들어야 하는 것들임



시험 문제와 답안을 전부 올려놨으니 대충 60 점만 넘기도록!!!
나중에 몇몇 사람들 선별해서 인터뷰도 존재함!

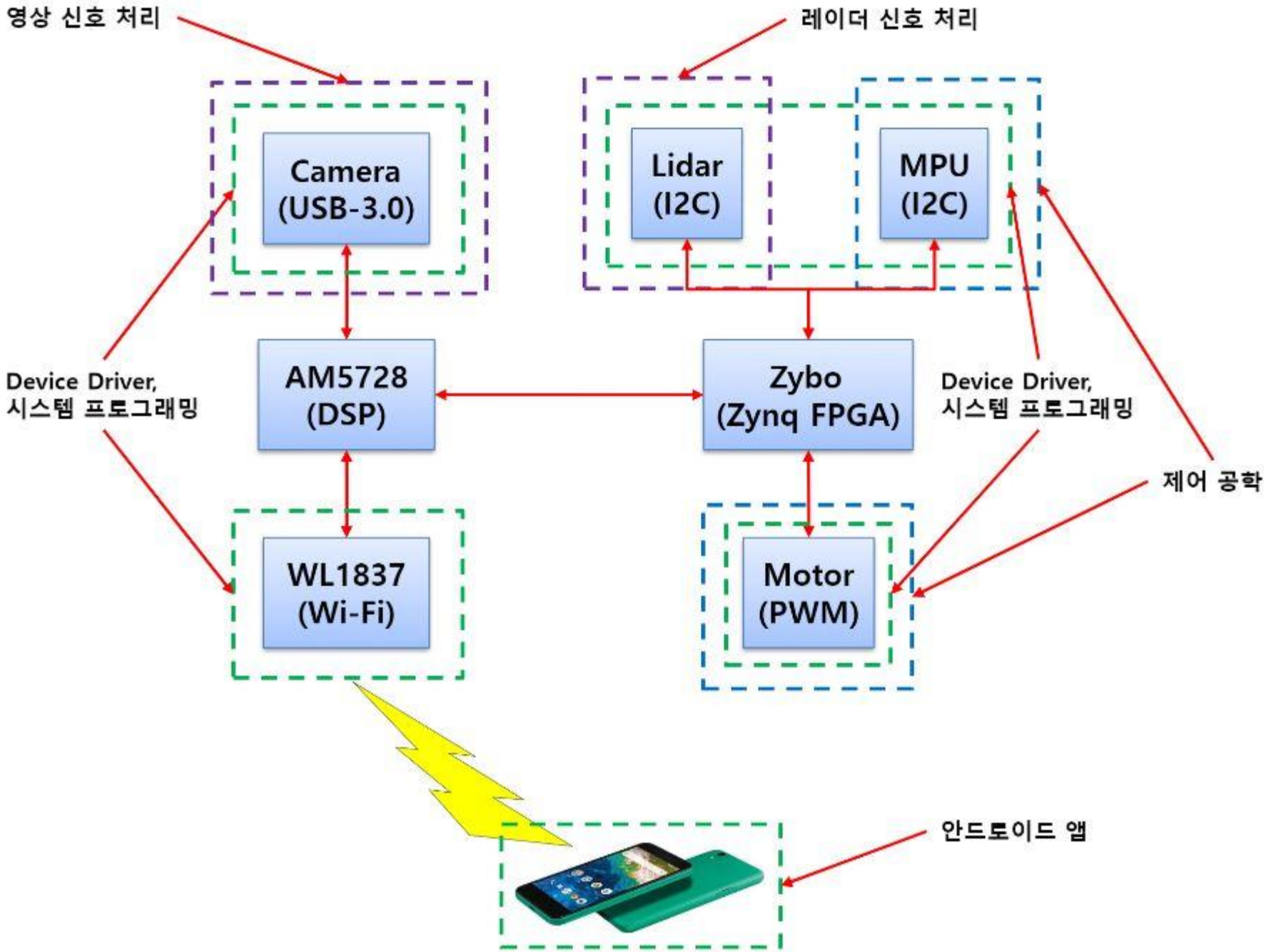
PI 제어 – 속도 제어

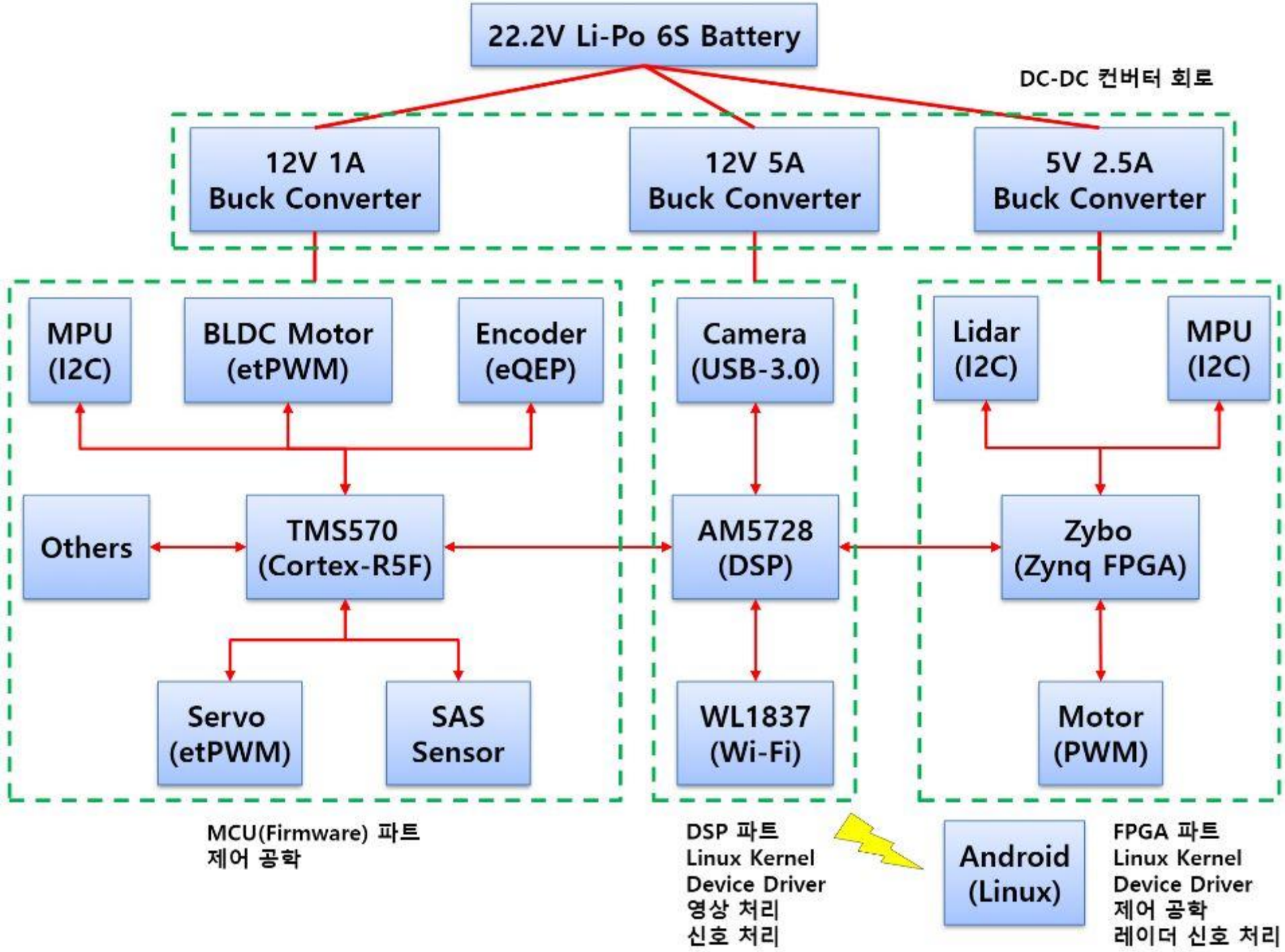
CAN 통신(1) – 왼쪽 및 오른쪽 각도 x 만큼 조향
– 정지
– 후진 등등



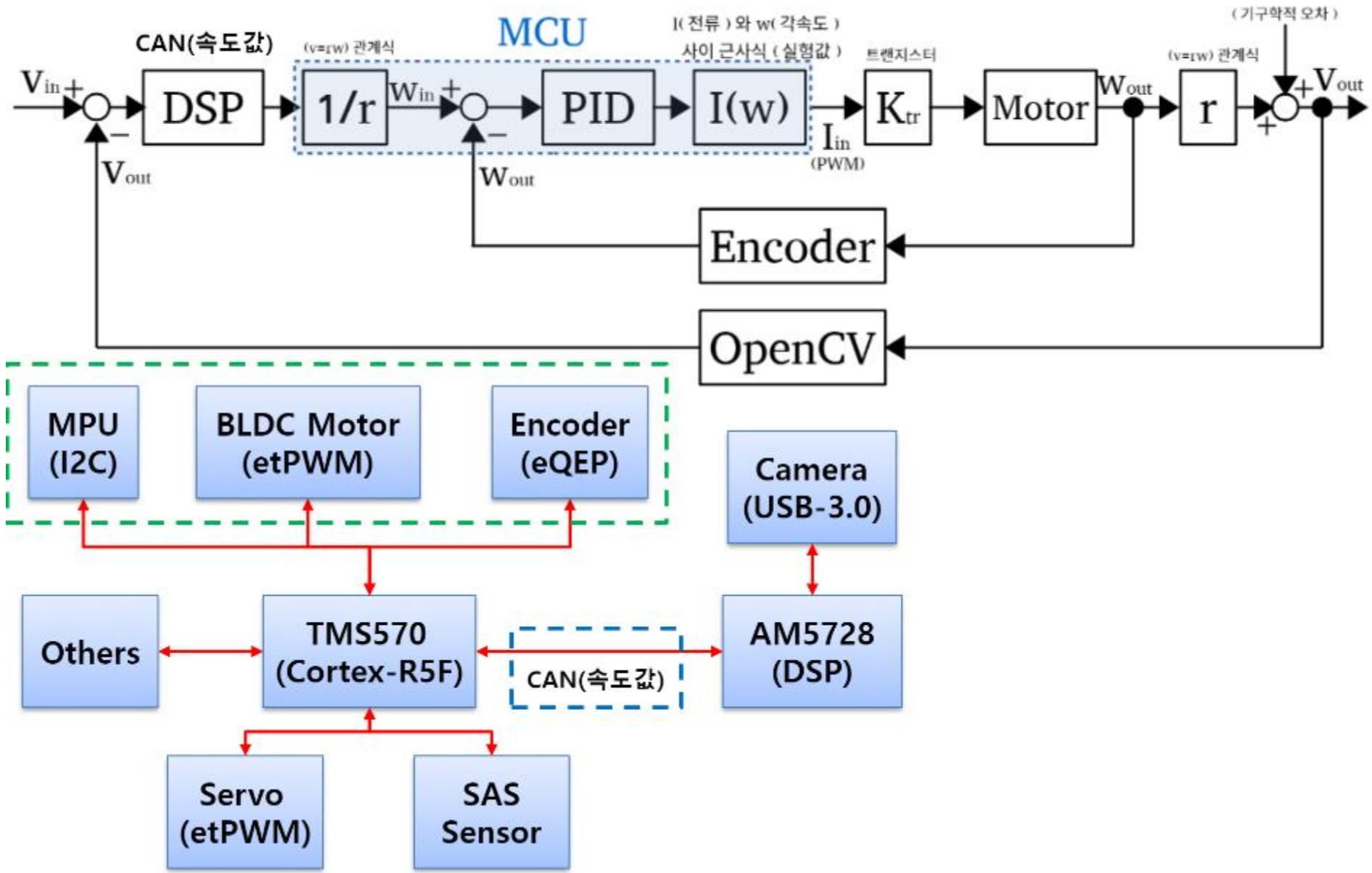
PID 제어 – 조향 제어

CAN 통신(2) – 현재 장애물이 어떤 방향에 존재하며
얼마만큼 떨어져있는지의 정보를 전송함

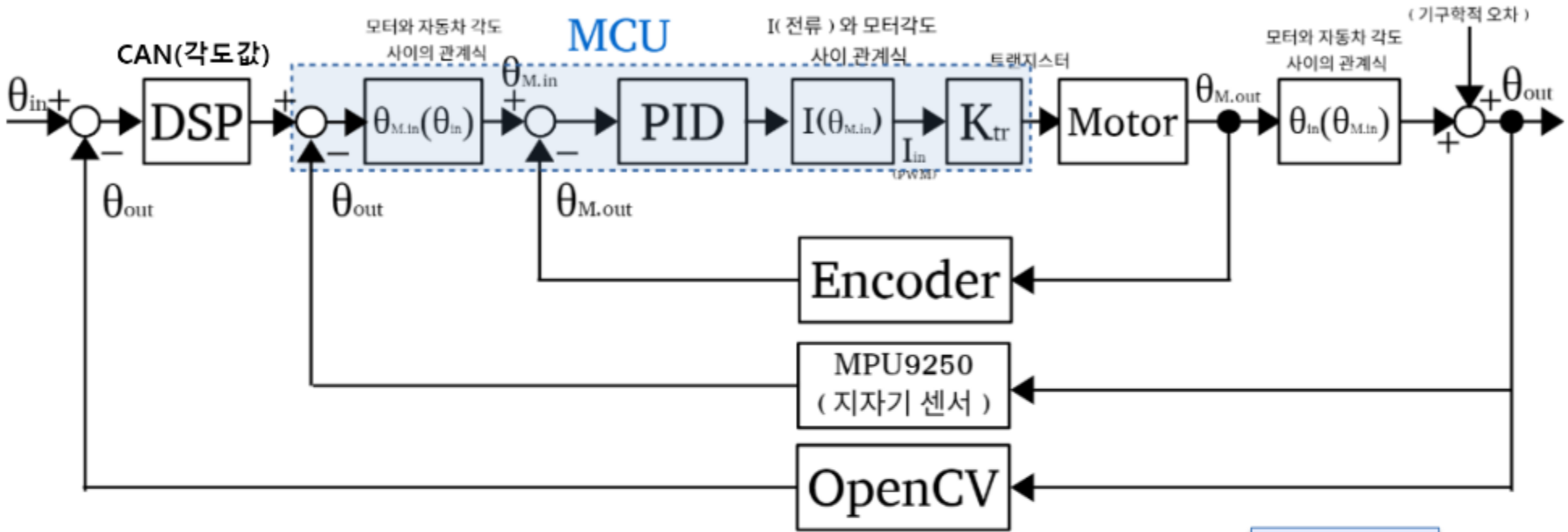

영상 신호 처리
레이더 신호 처리
Camera
(USB-3.0)
Lidar
(I2C)
MPU
(I2C)
Device Driver,
시스템 프로그래밍
AM5728
(DSP)
Zybo
(Zynq FPGA)
Device Driver,
시스템 프로그래밍
제어 공학
WL1837
(Wi-Fi)
Motor
(PWM)
안드로이드 앱

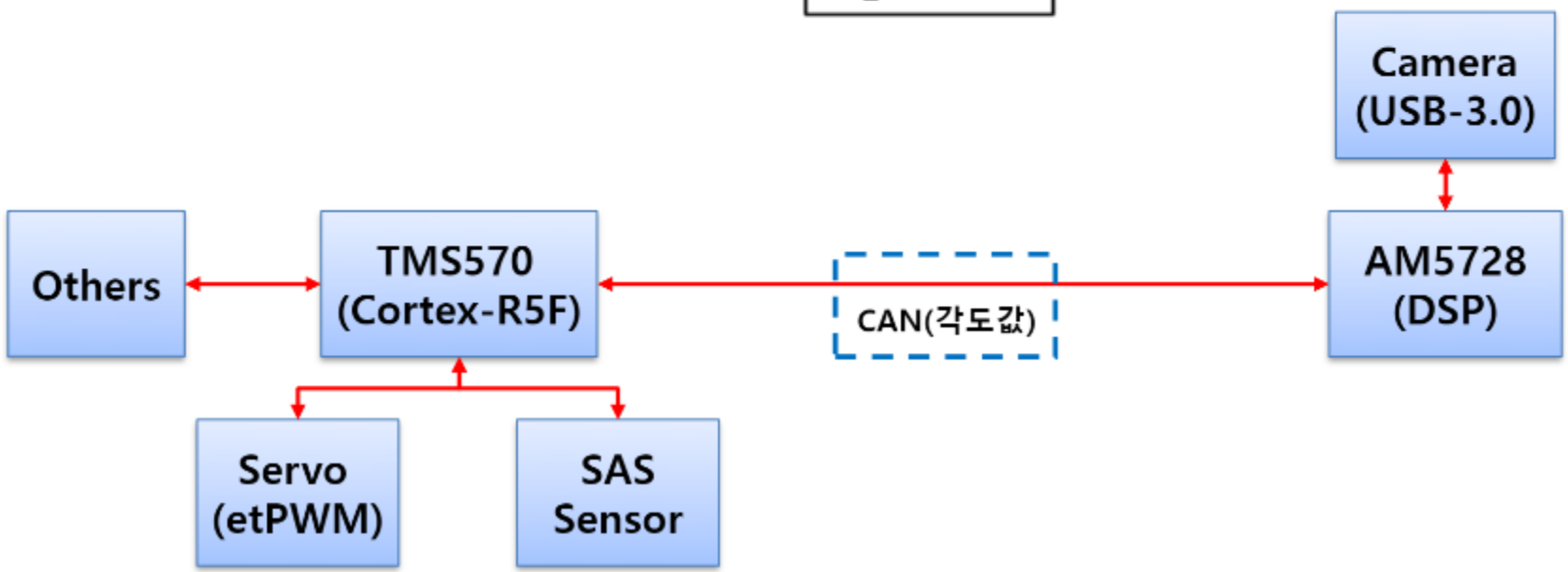

22.2V Li-Po 6S Battery
DC-DC 컨버터 회로
12V 1A
Buck Converter
12V 5A
Buck Converter
5V 2.5A
Buck Converter
MPU
(I2C)
BLDC Motor
(etPWM)
Encoder
(eQEP)
Camera
(USB-3.0)
Lidar
(I2C)
MPU
(I2C)
Others
TMS570
(Cortex-R5F)
AM5728
(DSP)
Zybo
(Zynq FPGA)
Servo
(etPWM)
SAS
Sensor
WL1837
(Wi-Fi)
Motor
(PWM)
Android
(Linux)
MCU(Firmware) 파트
제어 공학
DSP 파트
Linux Kernel
Device Driver
영상 처리
신호 처리
FPGA 파트
Linux Kernel
Device Driver
제어 공학
레이더 신호 처리

자동차 속력 PID 제어

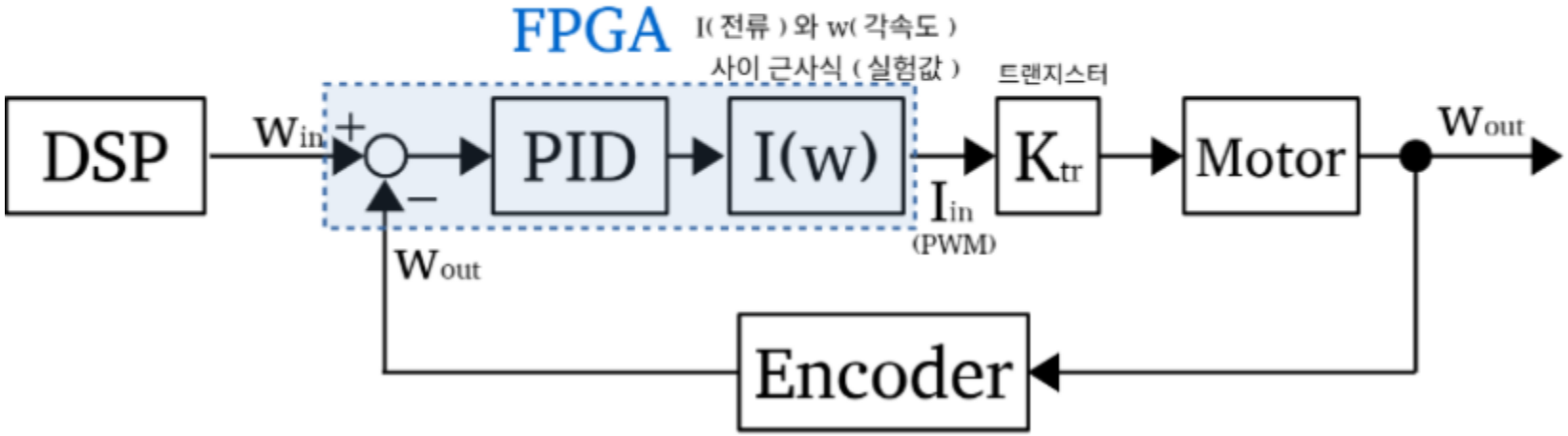

CAN(속도값)
(v=rw) 관계식
MCU
I(전류) 와 w(각속도)
사이 근사식 (실험값)
트랜지스터
(기구학적 오차)
(v=rw) 관계식
Vin
DSP
1/r
win
PID
I(w)
Iin
(PWM)
Ktr
Motor
wout
r
Vout
Vout
wout
Encoder
OpenCV
MPU
(I2C)
BLDC Motor
(etPWM)
Encoder
(eQEP)
Camera
(USB-3.0)
Others
TMS570
(Cortex-R5F)
CAN(속도값)
AM5728
(DSP)
Servo
(etPWM)
SAS
Sensor

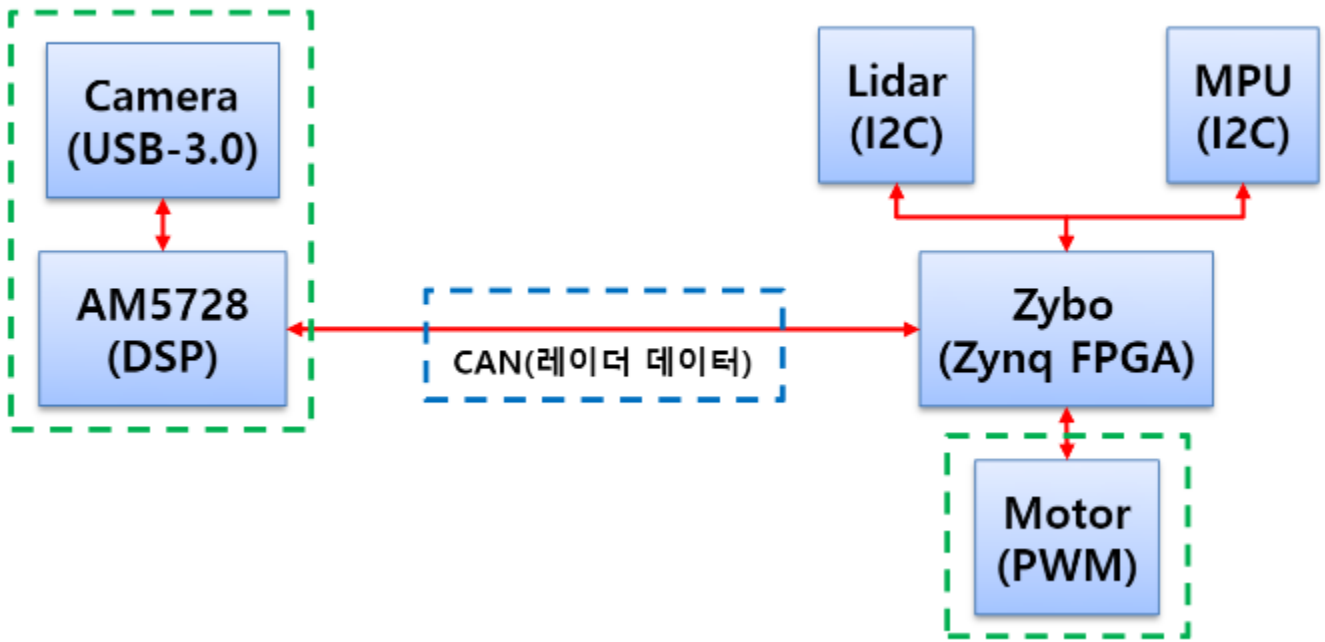
자동차 조향 PID 제어


CAN(각도값)
θin
DSP
모터와 자동차 각도 사이의 관계식
MCU
θM.in
θM.in(θin)
PID
I(전류)와 모터각도 사이 관계식
I(θM.in)
Iin (PWM)
Ktr
트랜지스터
Motor
θM.out
모터와 자동차 각도 사이의 관계식
θin(θM.in)
(기구학적 오차)
θout
θout
θout
θM.out
Encoder
MPU9250
(지자기 센서)
OpenCV

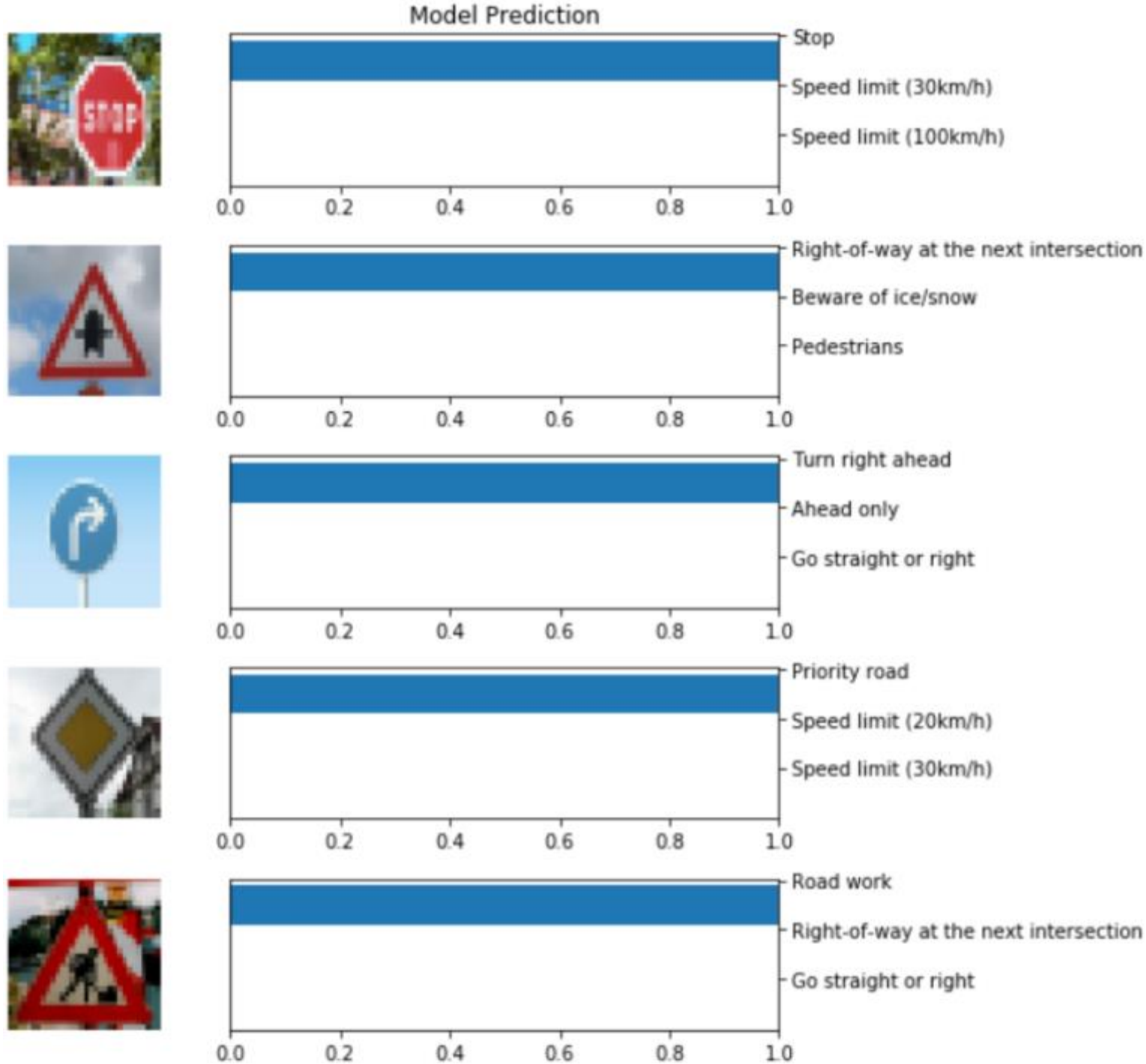

Camera
(USB-3.0)
Others
TMS570
(Cortex-R5F)
CAN(각도값)
AM5728
(DSP)
Servo
(etPWM)
SAS
Sensor

라이다 모터 PID 제어


FPGA
I(전류) 와 w(각속도)
사이 근사식 (실험값)
트랜지스터
DSP
Win
+
−
PID
I(w)
Iin
(PWM)
Ktr
Motor
Wout
Wout
Encoder

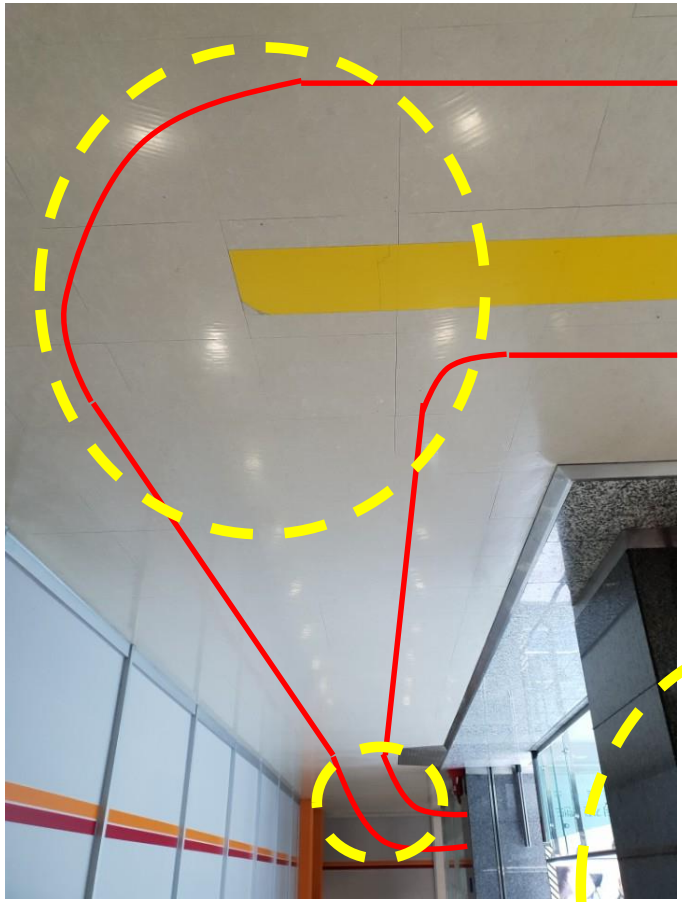

Camera
(USB-3.0)
AM5728
(DSP)
CAN(레이더 데이터)
Lidar
(I2C)
MPU
(I2C)
Zybo
(Zynq FPGA)
Motor
(PWM)


Left curvature: 200.6 m.
Right curvature: 147.5 m.
Off the center: -0.2 m.
Left -> Right RANSAC + L2 regr.
Inliers: 9365 | 11527
Curvatures: 1.68 | 1.52
W1: [-0.12374024 0.07627225 0.30087566]
W2: [0.18232602 0.28597677 0.32917155]
Right -> Left RANSAC + L2 regr.
Inliers: 9388 | 11521
Curvatures: 1.71 | 1.59
W1: [-0.12457982 0.08085257 0.2947036]
W2: [0.18104008 0.29381081 0.33702777]
RGB gradients mask
HSV gradients mask
Previous frame + L2 regr.
Inliers: 9279 | 8898
Curvatures: 1.69 | 1.26
W1: [-0.12148328 0.07708663 0.29763752]
W2: [0.18000598 0.22062097 0.4254041]

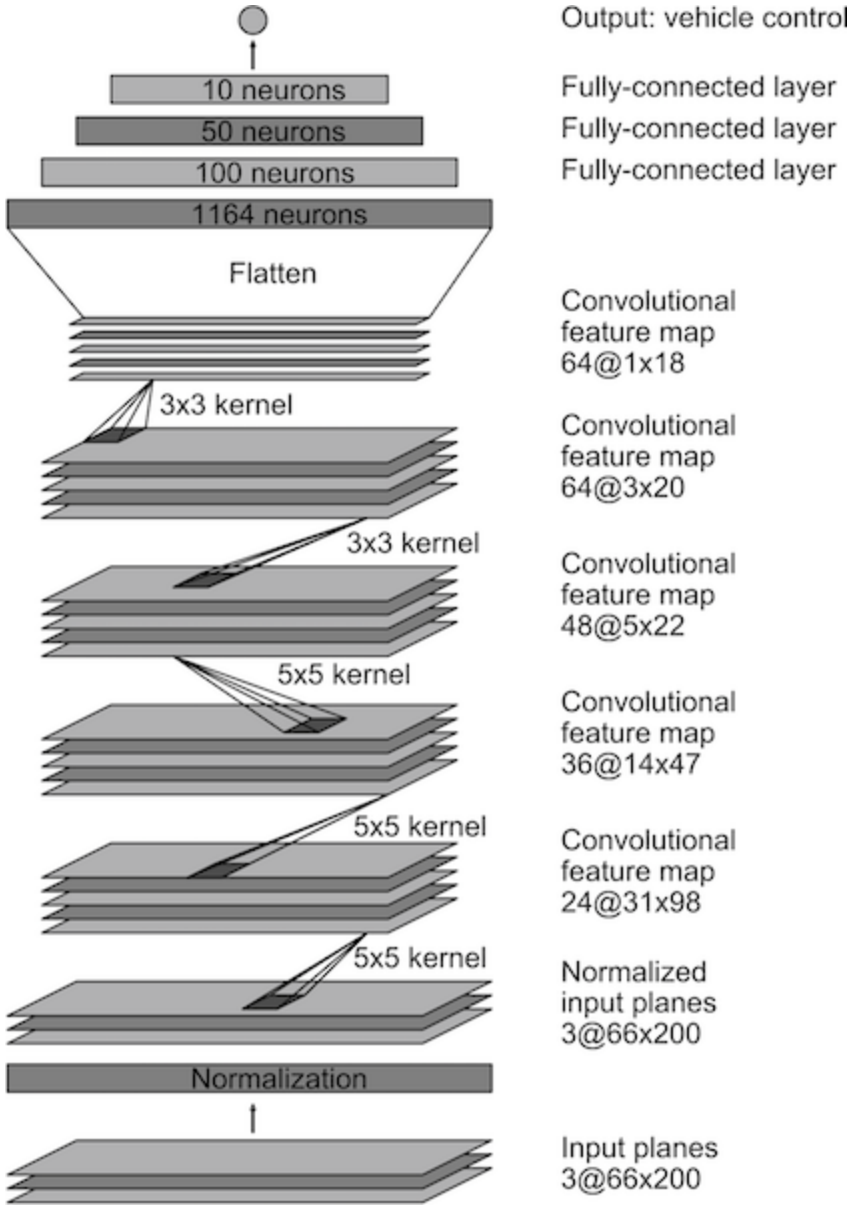

Model Prediction
Stop
Speed limit (30km/h)
Speed limit (100km/h)
0.0
0.2
0.4
0.6
0.8
1.0
Right-of-way at the next intersection
Beware of ice/snow
Pedestrians
0.0
0.2
0.4
0.6
0.8
1.0
Turn right ahead
Ahead only
Go straight or right
0.0
0.2
0.4
0.6
0.8
1.0
Priority road
Speed limit (20km/h)
Speed limit (30km/h)
0.0
0.2
0.4
0.6
0.8
1.0
Road work
Right-of-way at the next intersection
Go straight or right
0.0
0.2
0.4
0.6
0.8
1.0

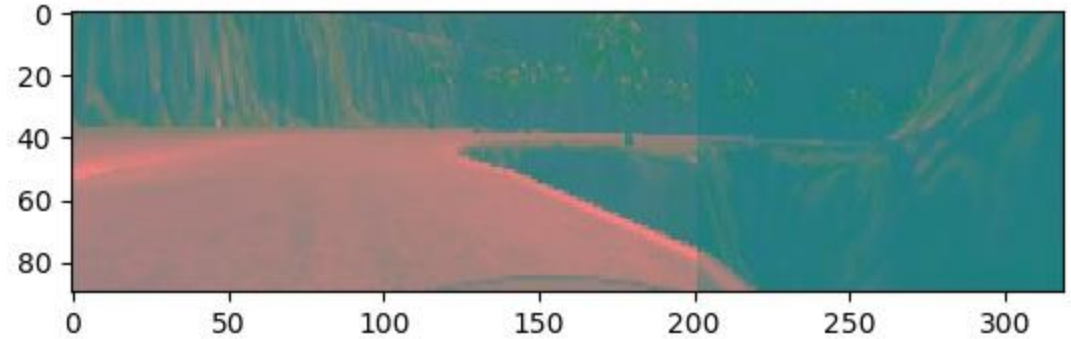
Driving Track

노란색원(급커브 구간)



Machine Learning

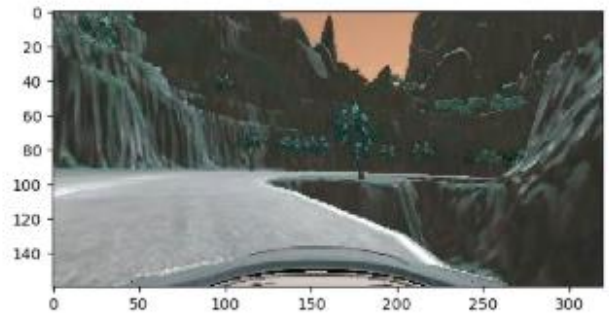
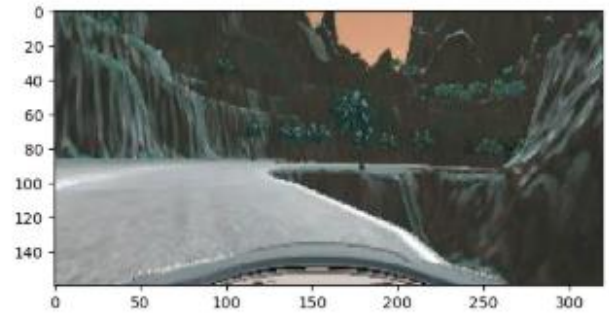
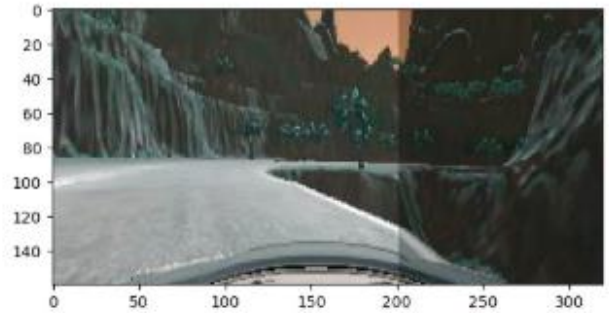
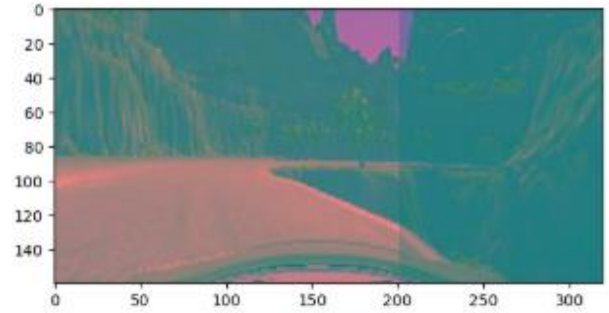
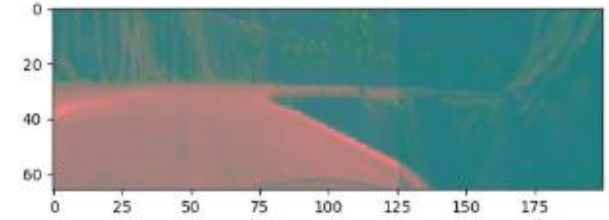
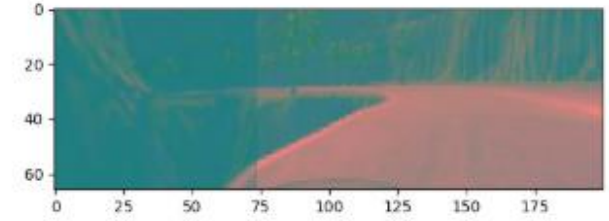

Output: vehicle control
10 neurons
Fully-connected layer
50 neurons
Fully-connected layer
100 neurons
Fully-connected layer
1164 neurons
Flatten
Convolutional feature map 64@1x18
3x3 kernel
Convolutional feature map 64@3x20
3x3 kernel
Convolutional feature map 48@5x22
5x5 kernel
Convolutional feature map 36@14x47
5x5 kernel
Convolutional feature map 24@31x98
5x5 kernel
Normalized input planes 3@66x200
Normalization
Input planes 3@66x200

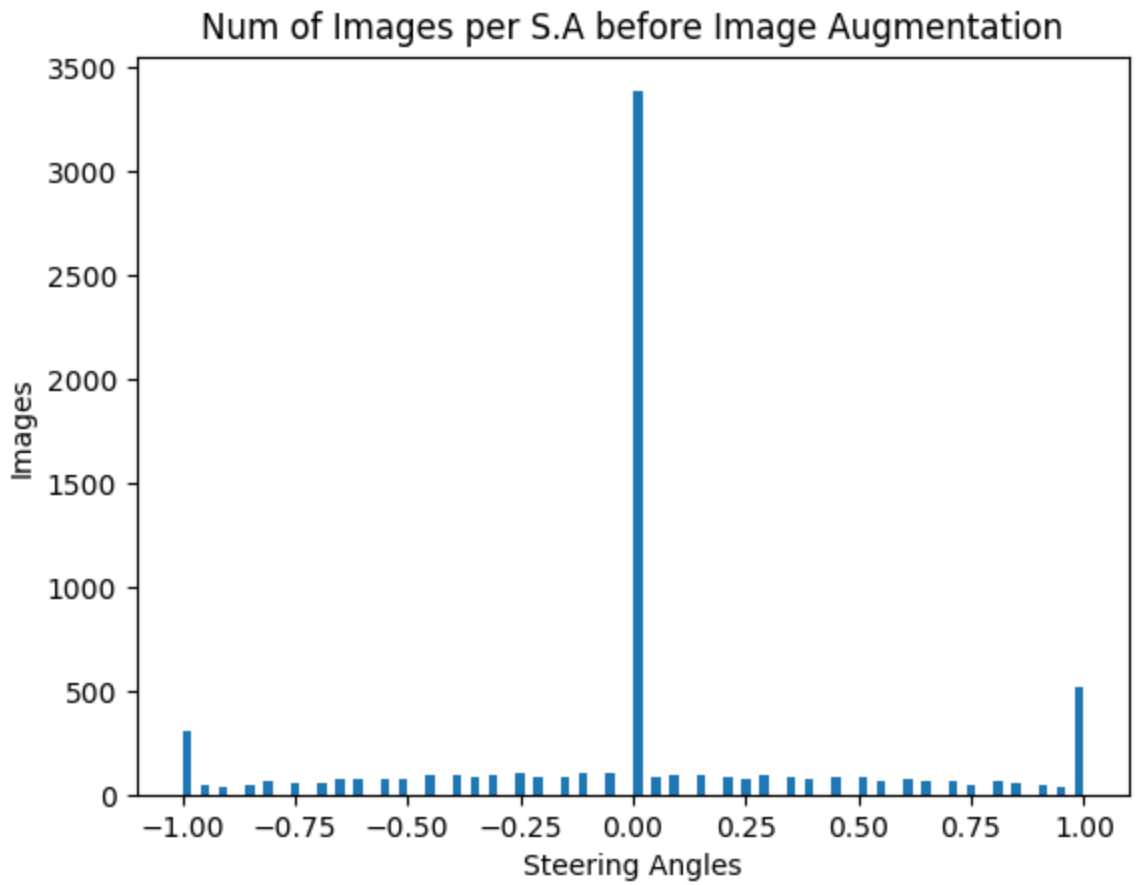

0
20
40
60
80
0
50
100
150
200
250
300

Left Camera Image

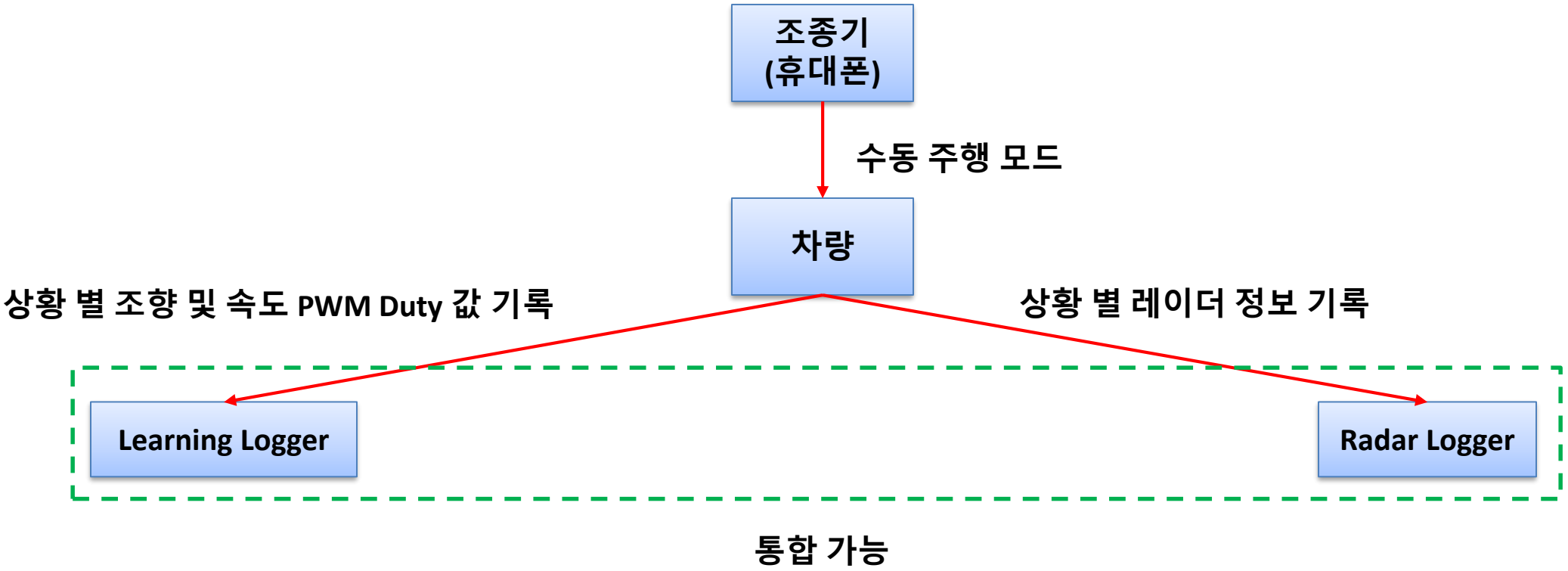
Center Camera Image

Right Camera Image

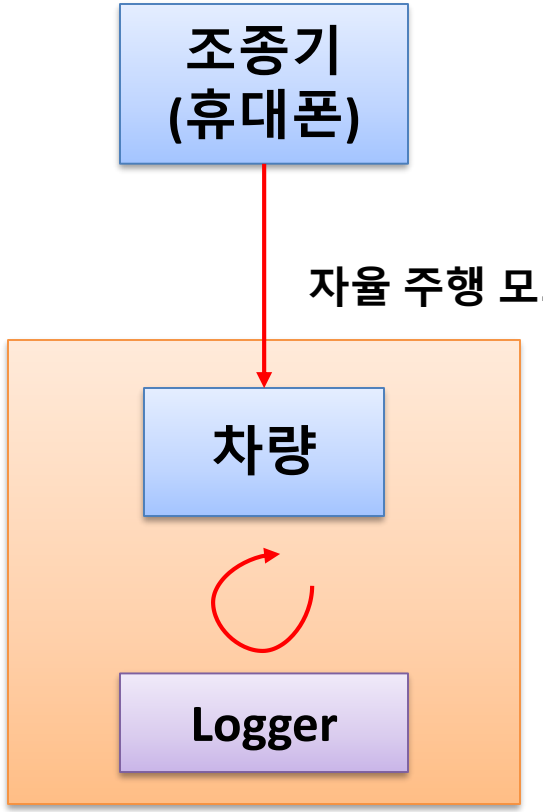
	Random Brightness		Horizon Shift
	Add Random Shadow		BGR2YUV
	Resize		Flip


Num of Images per S.A before Image Augmentation
Images
3500
3000
2500
2000
1500
1000
500
0
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
Steering Angles

Manual Driving



Autonomous Driving



MCU, DSP, FPGA 전체 구성 완료 가정

학습 데이터 활용

현재 진행중인 작업은 C++ 의 Nested Template 관련 문서
OpenCV 와 딥러닝을 물리기 위해서라면 반드시 OpenCL 이 필요함
딥러닝을 위한 OpenCL 문서, 그리고 딥러닝을 CPU + DSP 기반에서 C++ 로 작성하기 위한 최소한의 문서,
추가적으로 수학과 물리 설계 문서를 작성하고 있음.

또한 영상 처리나 딥러닝에 통계학이 들어가며 랜덤 프로세스에 대한 내용이 요구됨.
그 외에 DC-DC 컨버터 개발을 위한 문서 작업,
Lidar 신호 처리를 위한 문서 작업이 향후의 과제에 해당한다.