

2021 테크노니아 동계 현장실습 개발 보고서

최우석

목차

- 1. AI Camera**
 - 1-1. 개발환경**
 - 1-2. 적용 기술 개요**
 - 1-3. Flow Chart**
 - 1-4. UML**
 - 1-5. 문서**
 - 1-6. 스크린샷**

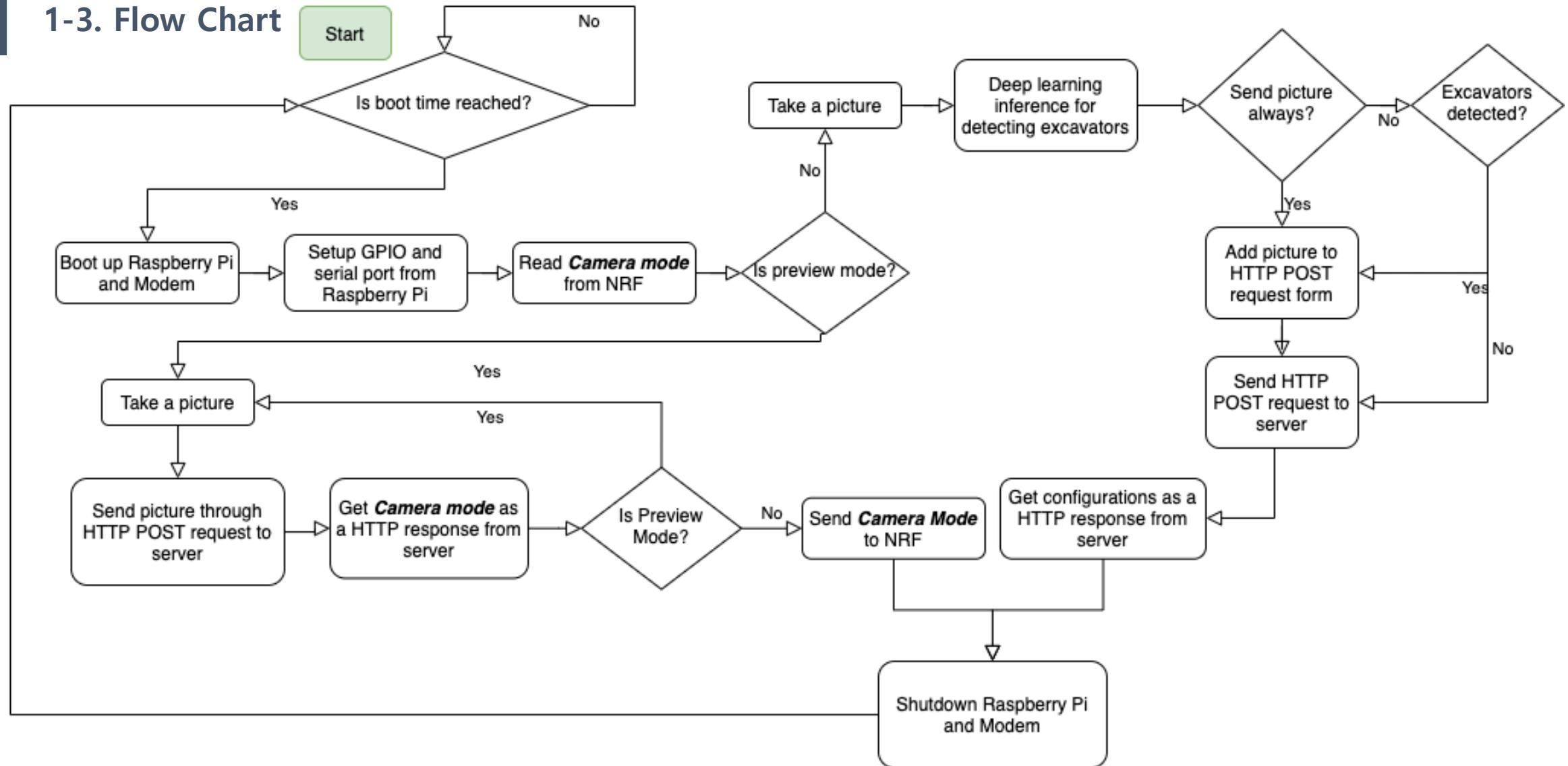
| 1-1. 개발환경

개발도구	Git, vscode, vim, cmake
언어	C++
OS 환경	Raspberry Pi OS
Target Device	Codezoo CAT.M1 Modem, NRF Board, Raspberry Pi 4B with Camera
프로젝트 위치	https://github.com/UmileVX/ino-on_AICamera

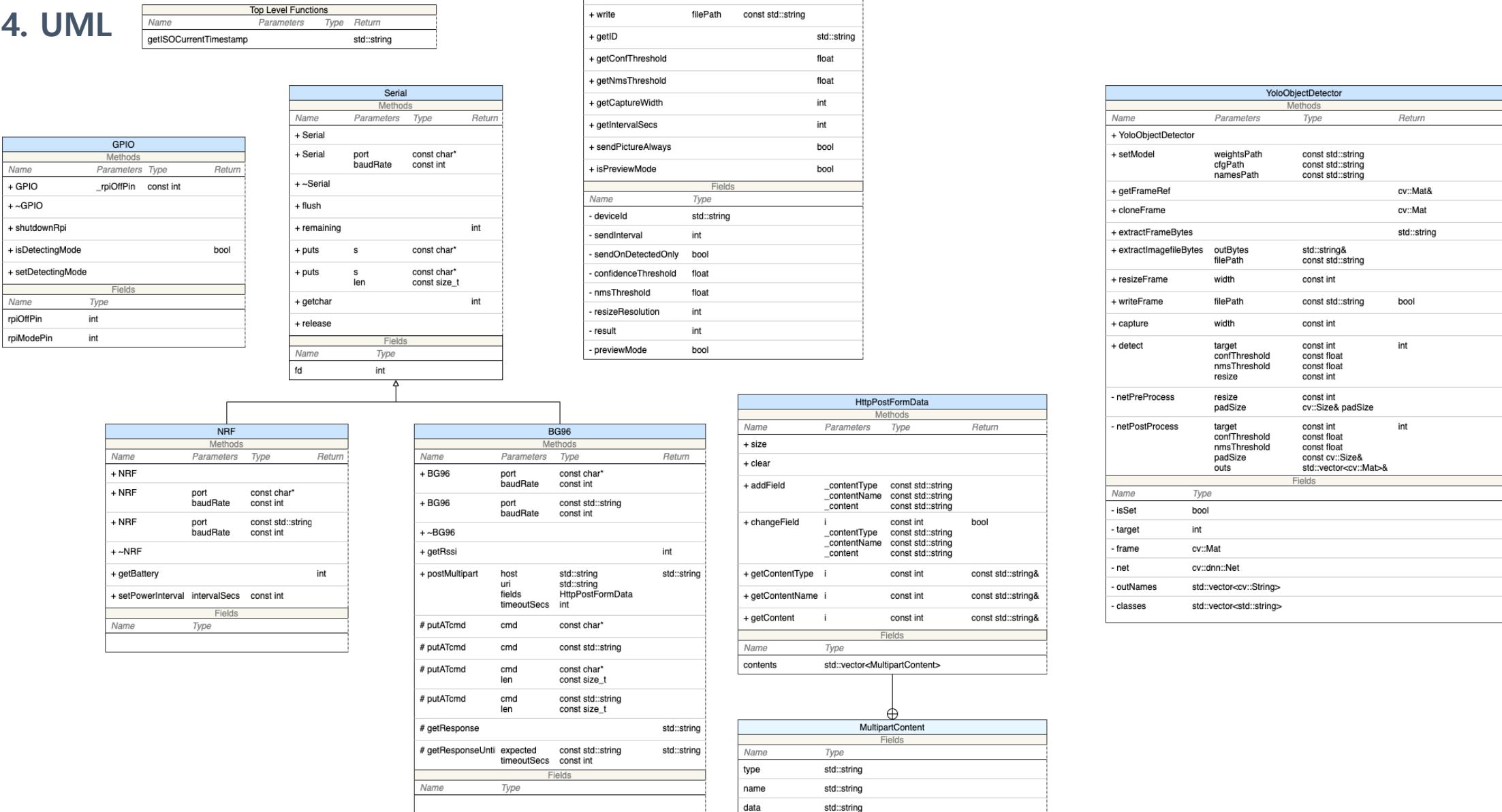
1-2. 적용 기술 개요

패키지명	버전	설명
WiringPi	2.52	Raspberry Pi GPIO control
OpenCV	4.5	Image processing and deep learning
JsonCpp	1.9.4	Json parser library for C++
Date	3	Date library for C++
Darknet		Deep learning training framework

1-3. Flow Chart



1-4. UML

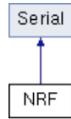


1-5. 문서

NRF Class Reference

```
#include <NRF.hpp>
```

Inheritance diagram for NRF:



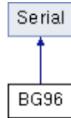
Public Member Functions

NRF ()
NRF (const char *port, const int baudRate)
NRF (const std::string port, const int baudRate)
~NRF ()
int getBattery () const
void setPowerInterval (const int intervalSecs) const

BG96 Class Reference

[#include <BG96.hpp>](#)

Inheritance diagram for BG96:



Public Member Functions

BG96 (const char *port, const int baudRate)
BG96 (const std::string port, const int baudRate)
~BG96 ()
int getRssi () Get RSSI of modem through AT command. Try 10 times to get RSSI if AT response is invalid value as RSSI. More...
std::string postMultipart (const std::string host, const std::string uri, const HttpPostFormData &fields, const int timeoutSecs) Send HTTP Post request through AT command. More...
void putATcmd (const char *cmd) Send AT command. All AT syntax must be followed. There shouldn't be null character in the command. If it is, use an overridden method that includes "len" in the parameter. More...
void putATcmd (std::string cmd) Send AT command. All AT syntax must be followed. There shouldn't be null character in the command. If it is, use an overridden method that includes "len" in the parameter. More...
void putATcmd (const char *cmd, const size_t len) Send AT command. All AT syntax must be followed. More...
void putATcmd (std::string cmd, const size_t len) Send AT command. All AT syntax must be followed. More...
std::string getResponse () Get AT response. More...
std::string waitResponseUntil (const std::string expected, const int timeoutSecs) Wait AT response until it has sub-string of "expected". More...

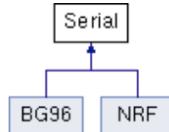
1-5. 문서

Serial Class Reference

[List of all members](#)

```
#include <Serial.hpp>
```

Inheritance diagram for Serial:



Public Member Functions

```
Serial ()  
Serial (const char *port, const int baudRate)  
~Serial ()
```

Protected Member Functions

```
void flush ()  
    Flush the serial buffers. (both tx & rx) More...  
int remaining ()  
    Return the number of bytes of data available to be read in the serial port. More...  
void puts (const char *s)  
    Send a string to the serial port. More...  
void puts (const char *s, const size_t len)  
    Send a string to the serial port. More...  
int getchar ()  
    Get a single character from the serial device. Note: Zero is a valid character and this function will time-out  
    after 10 secs. More...  
void release ()  
    Release the serial port. More...
```

Protected Attributes

```
int fd
```

1-5. 문서

Config Class Reference

```
#include <Config.hpp>
```

Public Member Functions

`Config ()`

`void readFromFile (const std::string filePath)`

Read json from .json file and save it in this object. [More...](#)

`void readFromString (const std::string jsonString)`

Read json from string and save it in this object. [More...](#)

`void write (const std::string filePath) const`

Write json from this object to file. Not checking for invalid values. [More...](#)

`std::string getID () const`

`float getConfThreshold () const`

`float getNmsThreshold () const`

`int getCaptureWidth () const`

`int getIntervalSecs () const`

`bool sendPictureAlways () const`

GPIO Class Reference

```
#include <GPIO.hpp>
```

Public Member Functions

`GPIO (const int _rpiOffPin, const int _rpiModePin)`

`void shutdownRpi ()`

Write HIGH into GPIO::rpiOffPin pin for shutting down Raspberry Pi. [More...](#)

`bool isDetectingMode ()`

Read GPIO::rpiModePin. [More...](#)

`void setDetectingMode ()`

Write LOW into GPIO::rpiModePin pin. [More...](#)

1-5. 문서

HttpPostFormData Class Reference

```
#include <HttpPostFormData.hpp>
```

Classes

struct **MultipartContent**

Public Member Functions

int **size** () const

void **clear** ()

Remove all fields. [More...](#)

void **addField** (const std::string _contentType, const std::string _contentName, const std::string _content)

Add one field. Invalid values are not be checked. [More...](#)

bool **changeField** (const int i, const std::string _contentType, const std::string _contentName, const std::string _content)

Change one field. Invalid values are not be checked. [More...](#)

const std::string & **getContentType** (const int i) const

const std::string & **getContentName** (const int i) const

const std::string & **getContent** (const int i) const

HttpPostFormData::MultipartContent Struct Reference

```
#include <HttpPostFormData.hpp>
```

Public Attributes

std::string **type**

std::string **name**

std::string **data**

YoloObjectDetector Class Reference

```
#include <YoloObjectDetector.hpp>
```

Public Member Functions

YoloObjectDetector ()

void **setModel** (const std::string weightsPath, const std::string cfgPath, const std::string namesPath)
Import YOLOv4 model into this object. [More...](#)

Mat & **getFrameRef** ()

Mat **cloneFrame** () const

std::string **extractFrameBytes** ()

아직 미작동으로 사용 불가. [More...](#)

void **extractImagefileBytes** (std::string &outBytes, const std::string filePath)

Load image file and get its bytes binary. [More...](#)

void **resizeFrame** (const int width)

Resize frame with 4:3 ratio. [More...](#)

bool **writeFrame** (const std::string filePath) const

Write YoloObjectDetector::frame into file. [More...](#)

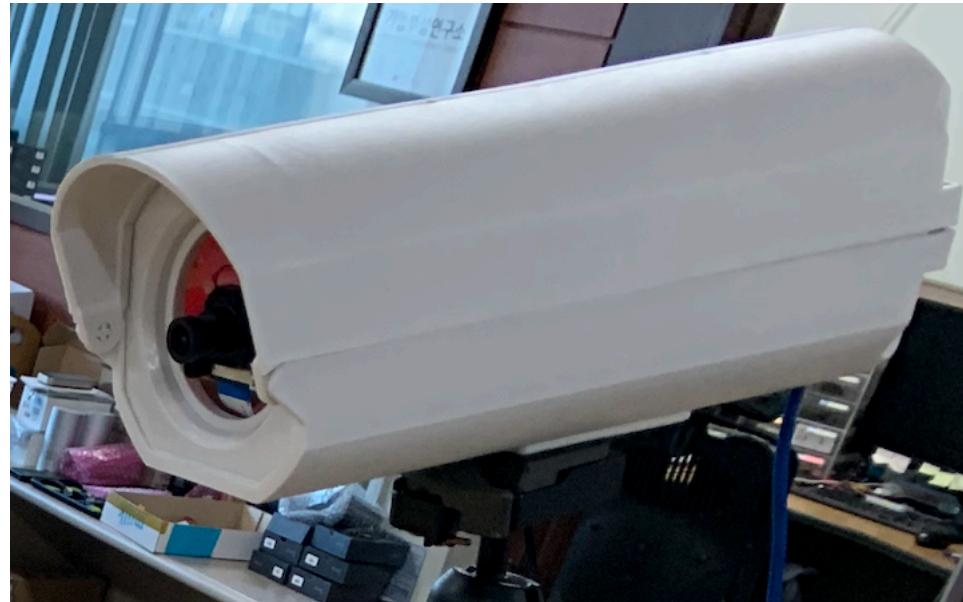
void **capture** (const int width)

Take a picture of raspi camera with 4:3 ratio and save into YoloObjectDetector::frame. [More...](#)

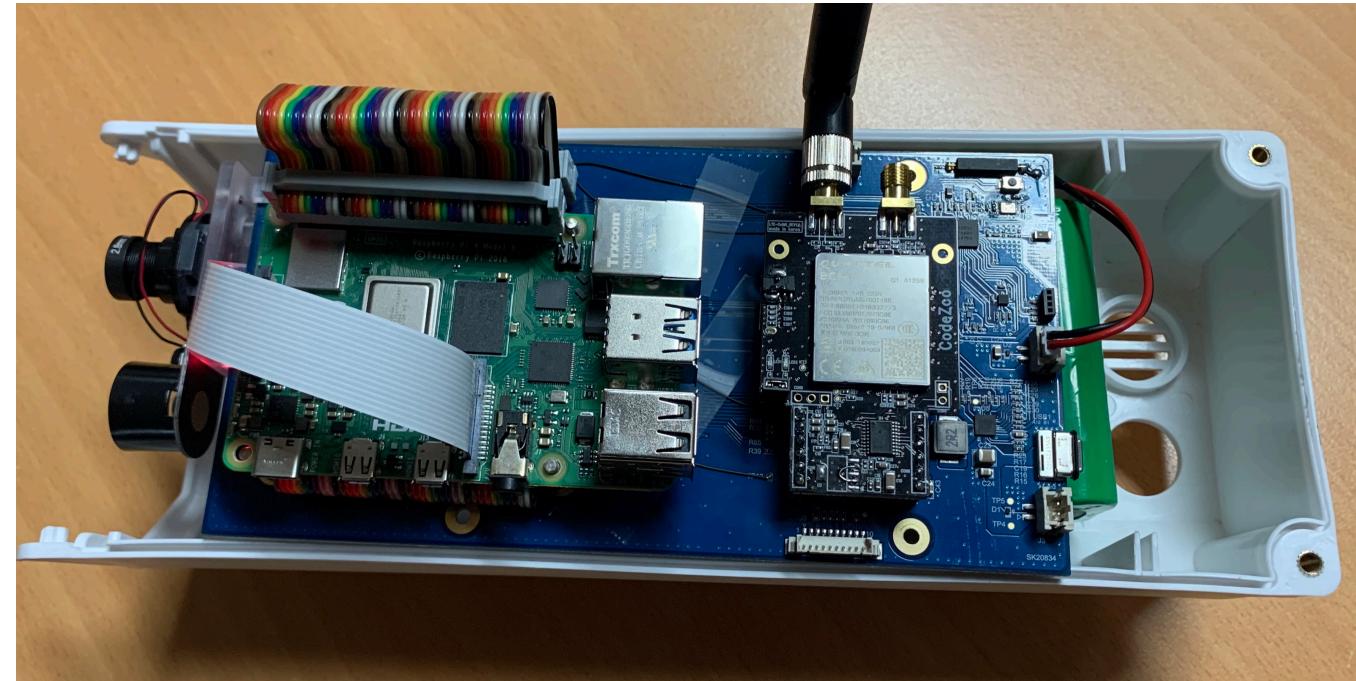
int **detect** (const int target, const float confThreshold, const float nmsThreshold, const int resize)

Run YOLOv4 inference with YoloObjectDetector::frame image. Result image with detected boxes and inference time is saved into YoloObjectDetector::frame. [YoloObjectDetector::setModel\(\)](#) should be called first. [More...](#)

1-6. 스크린샷



<제품 외형>



<제품 내부 구조>

1-6. 스크린샷

```

last-result.txt ▾
CUDNN_HALF=1
net.optimized_memory = 0
mini_batch = 1, batch = 64, time_steps = 1, train = 0
nms_kind: greendynms (1), beta = 0.600000
nms_kind: greendynms (1), beta = 0.600000
nms_kind: greendynms (1), beta = 0.600000

seen 64, trained: 384 K-images (6 Kilo-batches_64)

calculation mAP (mean average precision)...
Detection layer: 139 - type = 28
Detection layer: 150 - type = 28
Detection layer: 161 - type = 28

detections_count = 1029, unique_truth_count = 578
rank = 0 of ranks = 1029
rank = 100 of ranks = 1029
rank = 200 of ranks = 1029
rank = 300 of ranks = 1029
rank = 400 of ranks = 1029
rank = 500 of ranks = 1029
rank = 600 of ranks = 1029
rank = 700 of ranks = 1029
rank = 800 of ranks = 1029
rank = 900 of ranks = 1029
rank = 1000 of ranks = 1029
class_id = 0, name = excavator, ap = 98.15% (TP = 224, FP = 14)
class_id = 1, name = dump_truck, ap = 92.66% (TP = 238, FP = 35)
class_id = 2, name = concrete_mixer_truck, ap = 97.13% (TP = 78, FP = 5)

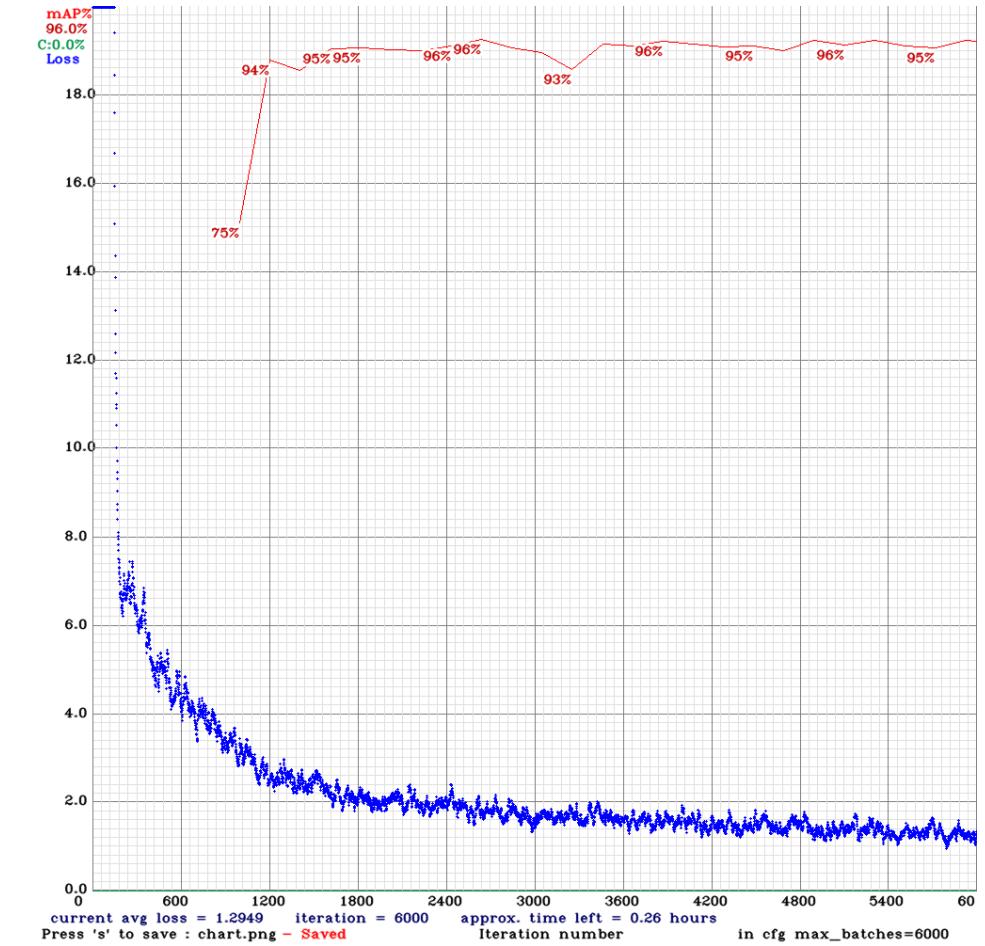
for conf_thresh = 0.25, precision = 0.91, recall = 0.93, F1-score = 0.92
for conf_thresh = 0.25, TP = 540, FP = 54, FN = 38, average IoU = 78.74 %

IoU threshold = 50 %, used Area-Under-Curve for each unique Recall
mean average precision (mAP@0.50) = 0.959766, or 95.98 %

Set -points flag:
`-points 101` for MS COCO
`-points 11` for PascalVOC 2007 (uncomment `difficult` in voc.data)
`-points 0` (AUC) for ImageNet, PascalVOC 2010-2012, your custom dataset

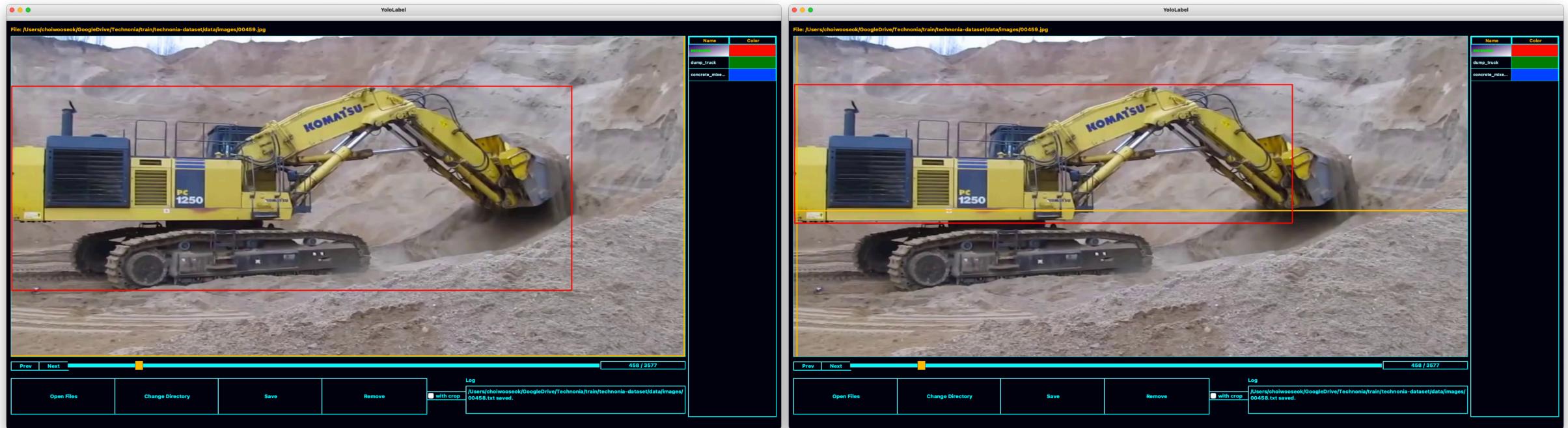
```

<딥러닝모델 테스트 결과>



<딥러닝 모델 학습 그래프>

1-6. 스크린샷



<딥러닝 모델의 최적화를 위한 데이터 라벨링 수정 예>

1-6. 스크린샷



<포크레인 검출 결과>

Not Secure — ino-on.umilevrx.com

Ino-on_AICamera: YoloObjectDetector Cl... INO ON | 이벤트 세부 정보 Tags · AlexeyAB/darknet admin@ino-on.com 22

INO ON

INO-ON-0005

이벤트 세부 정보

분류 INO-ON

설치일 2021년 02월 26일 10:33:41

최근 수신일 2021년 02월 26일 13:01:36

전파 강도 31

배터리 100

일련번호 INO-ON-0005

발생일 2021년 02월 25일 14:42:42

상태 검출

전파 강도 27

배터리 100

이벤트 목록으로 돌아가기

<서버에서 카메라 작동 결과 조회>