SAMSUNG Research

Seoul IoT x Tizen

Controlling LED Light with Motion Sensor

August 22, 2018

Boyeon Son

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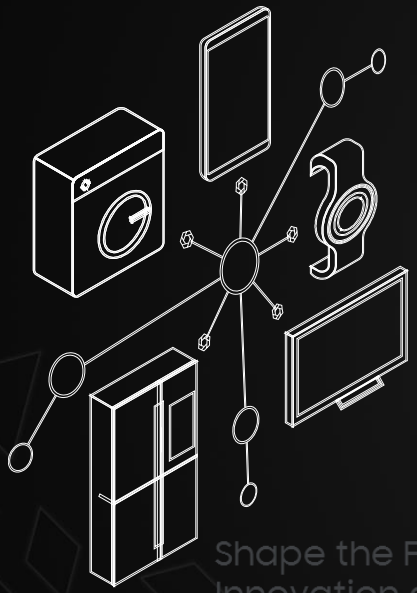

Shape the Future with
Innovation and Intelligence

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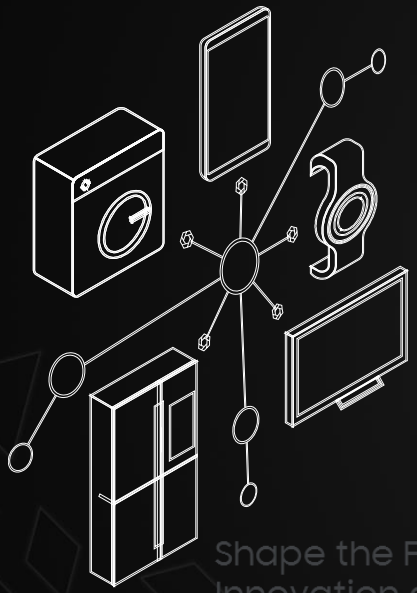

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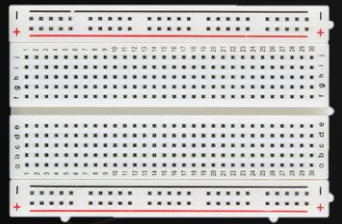
I Introduction

Introduction: Today's Goal

Eagleye 530s



빵판과 전선 ☺

모션 센서

(HC-SR501)

5파이 LED 전구

330Ω 저항

+

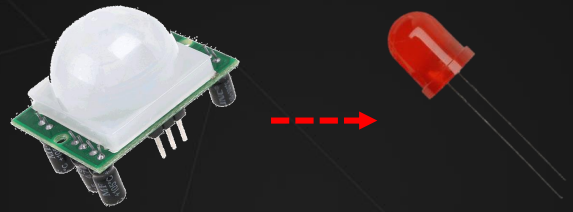
Tizen Studio

Tizen Studio

Introduction: Today's Goal

Introduction: Today's Goal

1. 모션 센서 값에 따라 LED 전구 On/Off 시키기



2. SmartThings App에서 디바이스(센서) 컨트롤하기

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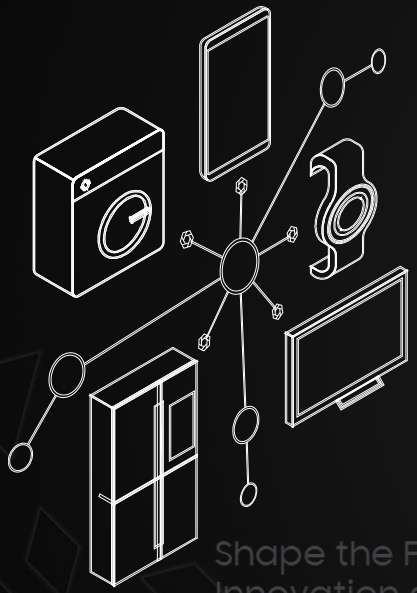

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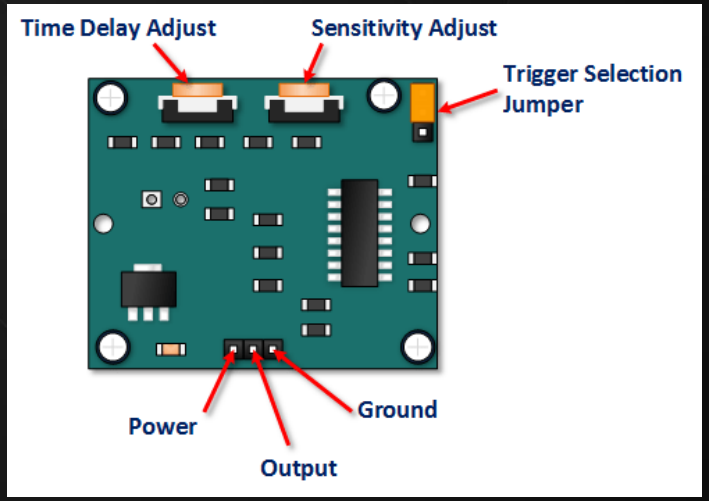
II Motion Light Control App

Hardware Setup

Hardware Setup: The Motion Sensor

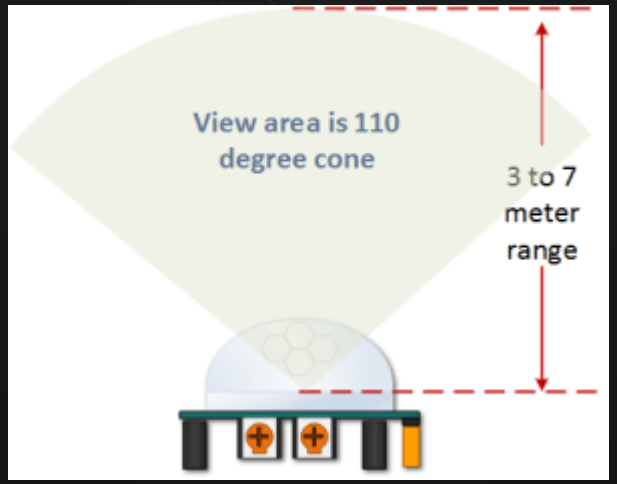
- **Passive Infrared Motion Sensor** (HC-SR501)
  - 사용자 메뉴얼 https://www.mpja.com/download/31227sc.pdf



Hardware Setup: The Motion Sensor

모션 감지 범위

- 3~7m 거리 안의 110도 부채꼴 모양 내 적외선 변화 감지



Hardware Setup: The Motion Sensor

감지 범위 조정

- 시계 방향으로 돌리면 감지 범위 감소 (min 3m)
- 반시계 방향으로 돌리면 감지 범위 증가 (max 7m)

Hardware Setup: The Motion Sensor

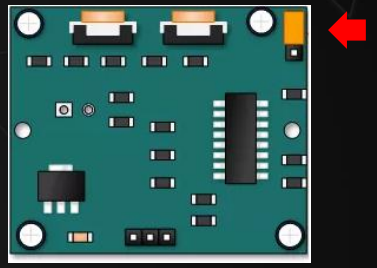
지연 시간 조정

- 움직임이 감지된 후부터 얼마동안 데이터가 'On'으로 머무를 지 결정
- 시계 방향으로 돌리면 지연 시간 증가 (max 5분)
- 반시계 방향으로 돌리면 지연 시간 감소 (min 3초)

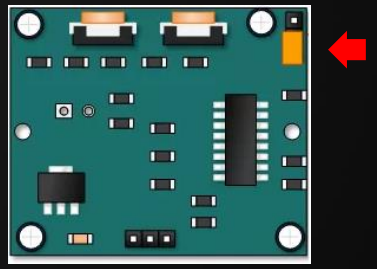
Hardware Setup: The Motion Sensor

트리거 모드 변경

- **Single 트리거 모드**: 최초 움직임이 감지되면 지연 시간이 시작되어 설정된 시간동안 움직임이 있어도 지연 시간이 갱신되지 않음



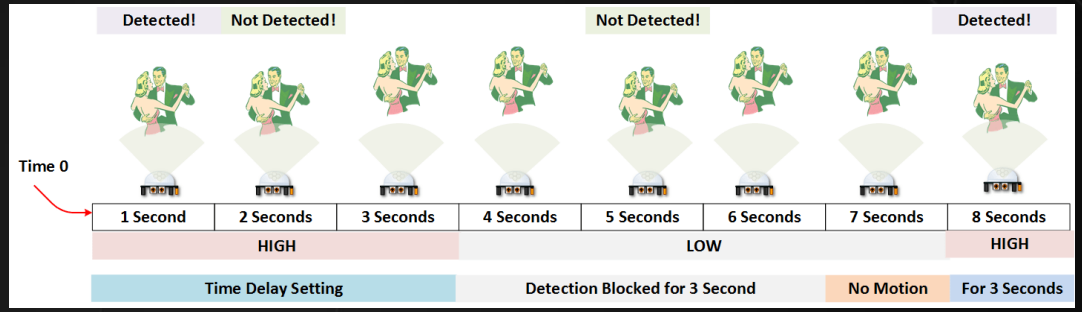
- **Repeatable 트리거 모드**: 움직임이 감지될 때마다 지연 시간이 갱신됨



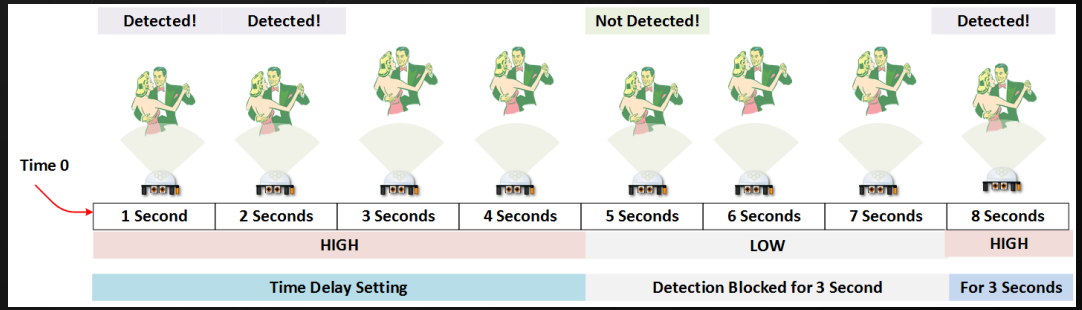
Hardware Setup: The Motion Sensor

⭘ 트리거 모드 / 지연 시간 예제

- Single 트리거
  지연시간 3초



- Repeatable 트리거
  지연시간 3초

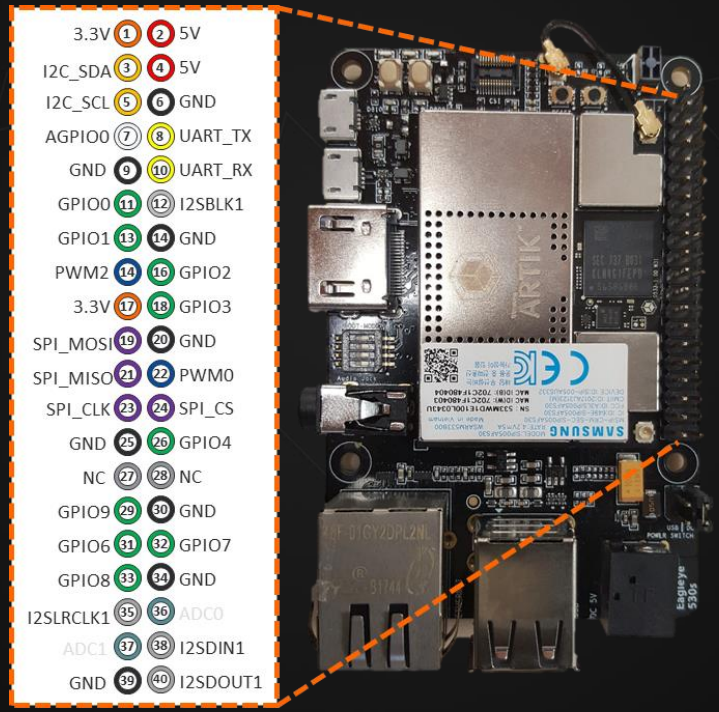


Hardware Setup: The Motion Sensor

실습 준비

Hardware Setup: The Eagleye 530s Board

Eagleye 530s Pins



Hardware Setup: Motion Sensor - Board

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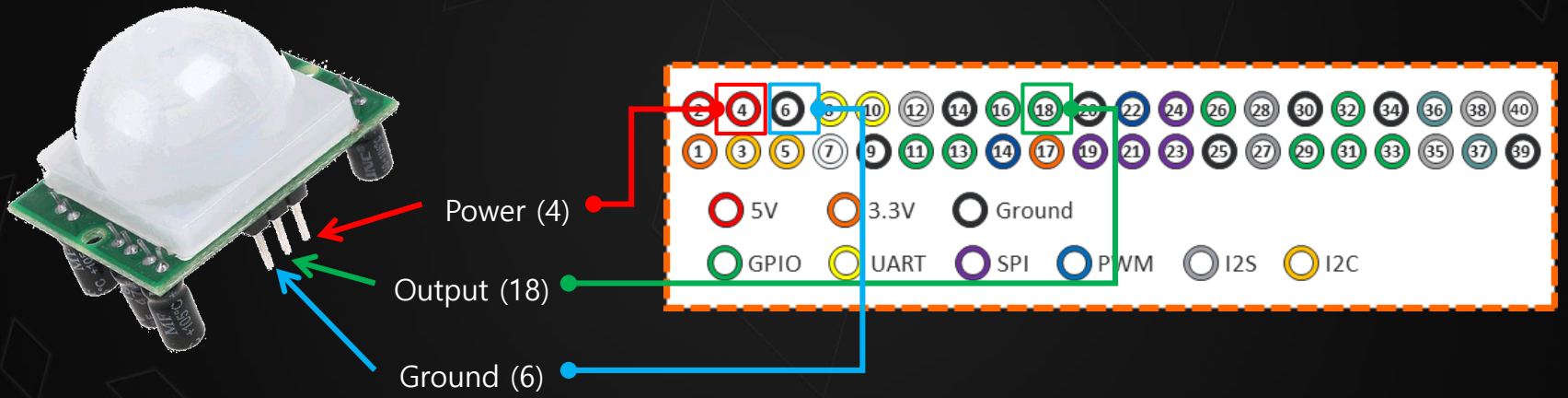
Eagleye Board - Motion Sensor 연결



Hardware Setup: The LED Light

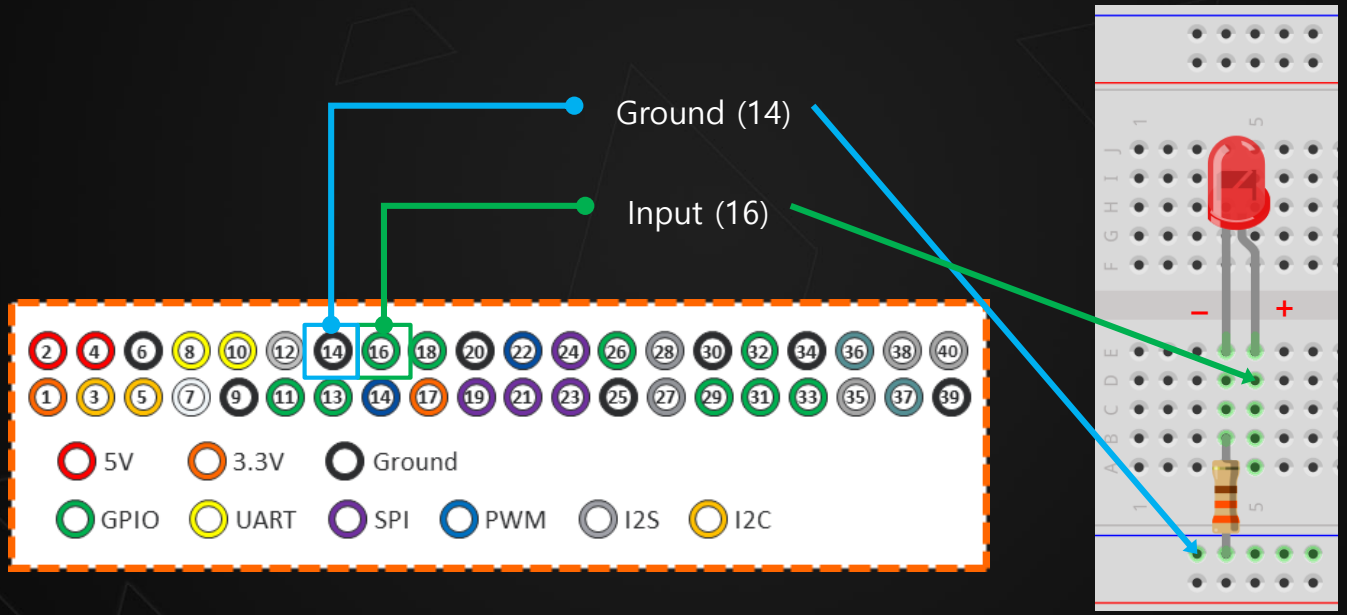
LED 전구 및 저항 연결

- 5파이 LED 전구 (전압 2.2V / 전류 50mA)

- 공급전압 5V 시, 100~400Ω 저항 사용

Hardware Setup: LED- Board

- Eagleye Board - LED 전구 및 저항 연결



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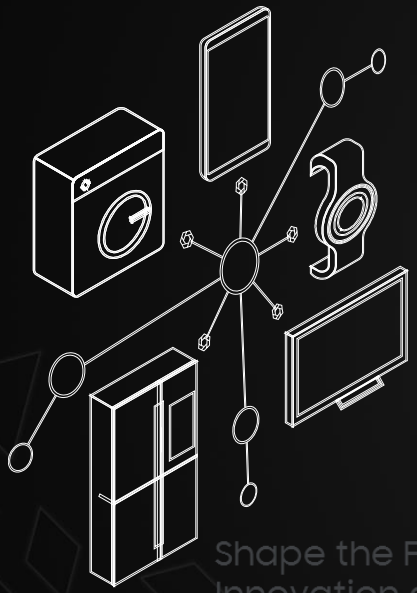

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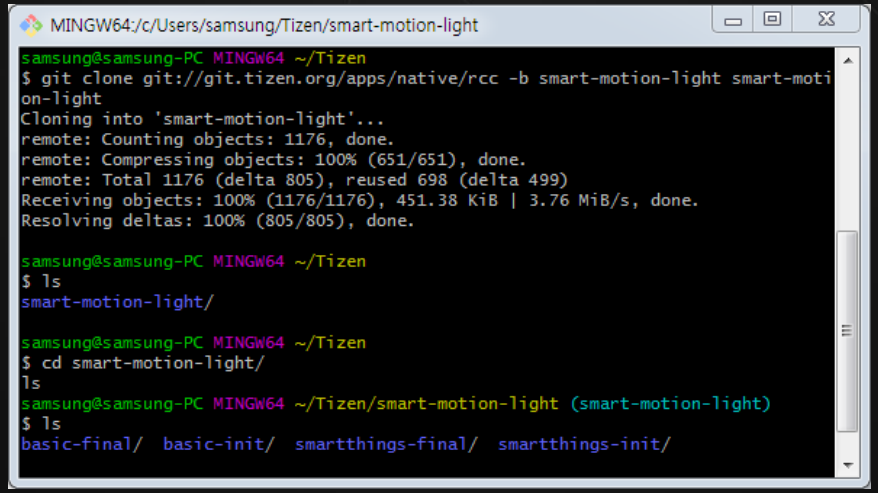
II Motion Light Control App

Code Implementation

Motion Light Control: Code Implementation

Git Bash에서 rcc/smart-motion-light 코드 clone 받기

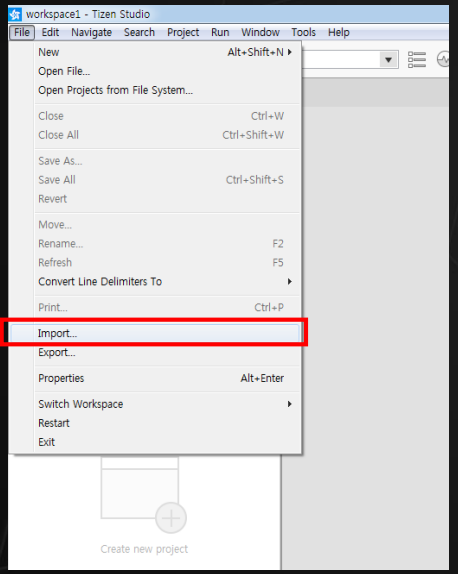
- git clone https://git.tizen.org/cgit/apps/native/rcc
  -b smart-motion-light smart-motion-light

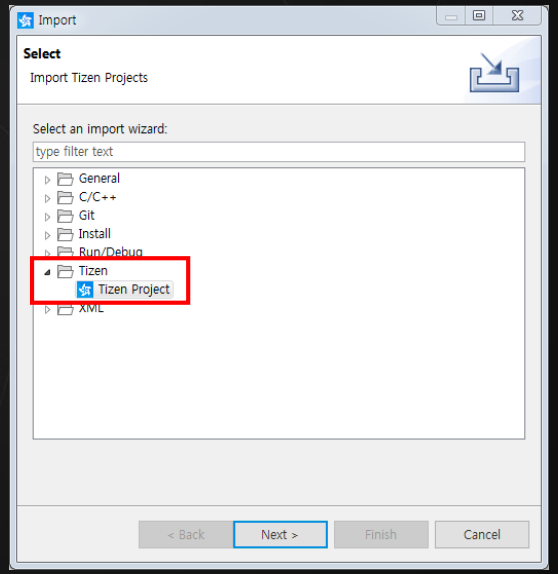


Motion Light Control: Code Implementation

Tizen Studio에서 motion-light-basic 프로젝트 불러오기

- File > Import 클릭 > Tizen > Tizen Project 선택

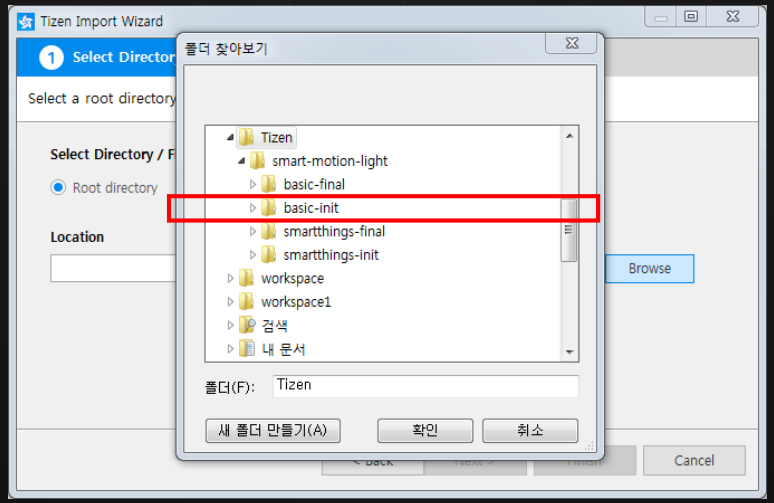




Motion Light Control: Code Implementation

Tizen Studio에서 motion-light-basic 프로젝트 불러오기

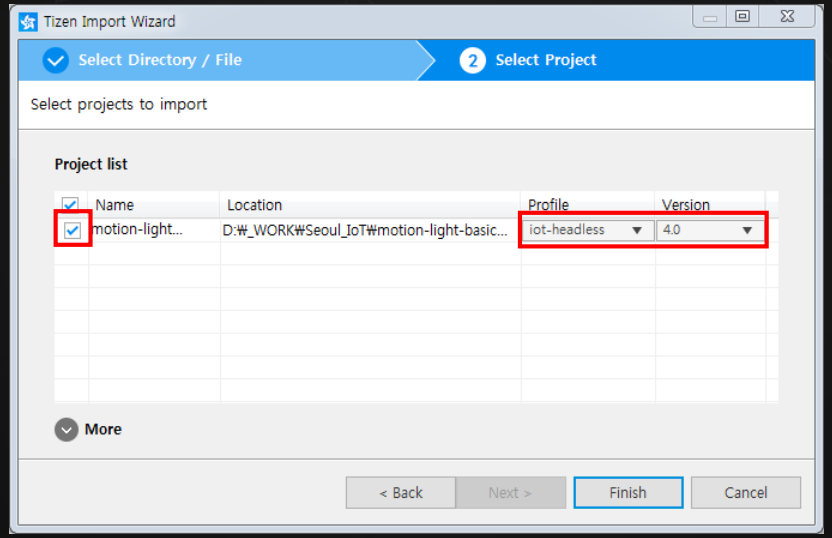
- Root directory 선택 > Browse 클릭
- smart-motion-light/basic-init 폴더 선택



Motion Light Control: Code Implementation

Tizen Studio에서 motion-light-basic 프로젝트 불러오기

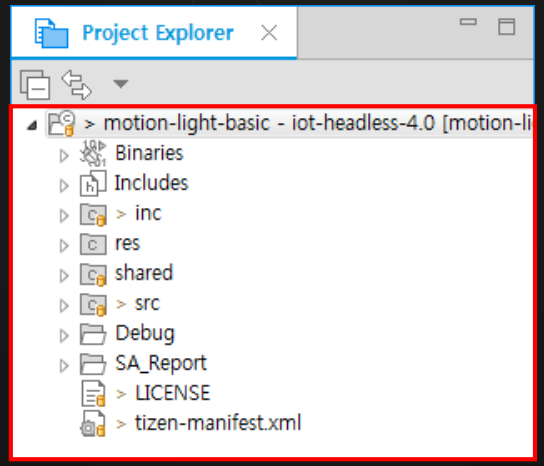
- Profile: iot-headless / Version: 4.0 선택 > 체크박스 선택



Motion Light Control: Code Implementation

Tizen Studio에서 motion-light-basic 프로젝트 불러오기

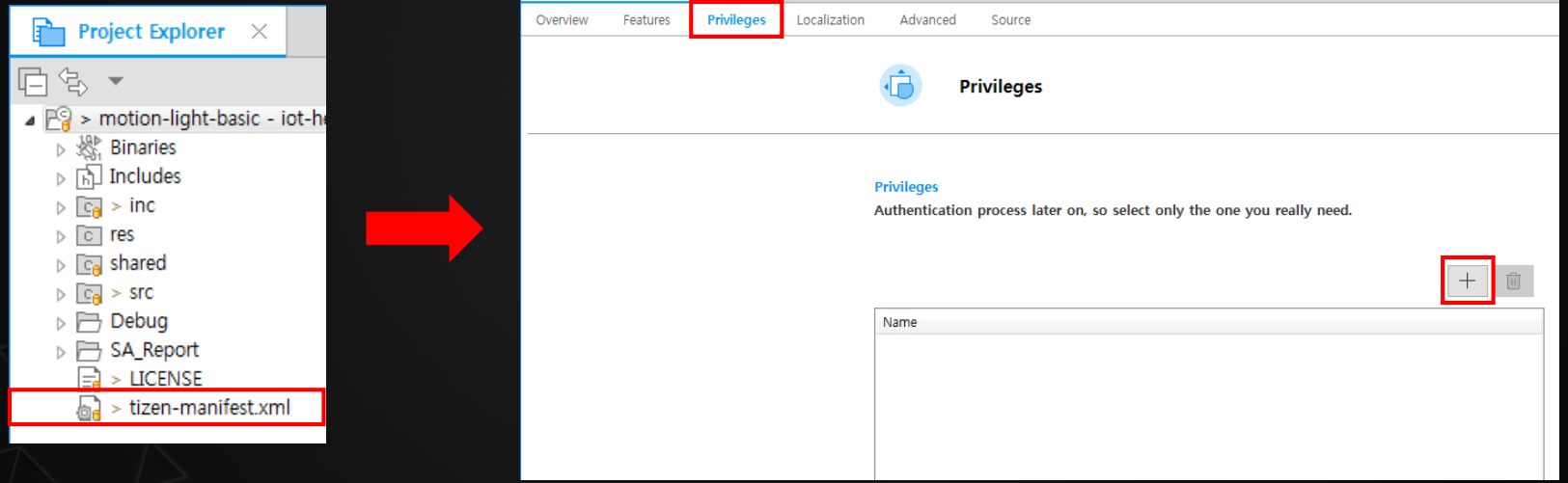
- Project Explorer에서 motion-light-basic 프로젝트 확인



Motion Light Control: Code Implementation

Peripheral IO API 사용을 위해 peripheralio privilege 추가

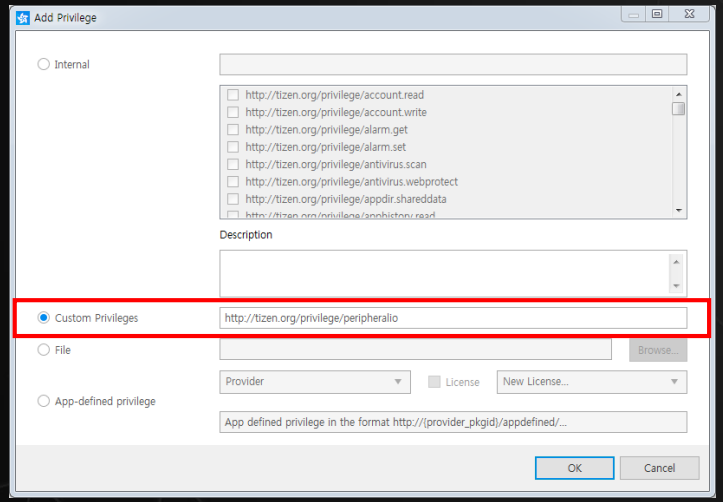
- tizen-manifest.xml 파일 선택 > Privileges 탭 > 추가(+) 버튼 클릭



Motion Light Control: Code Implementation

Peripheral IO API 사용을 위해 peripheralio privilege 추가

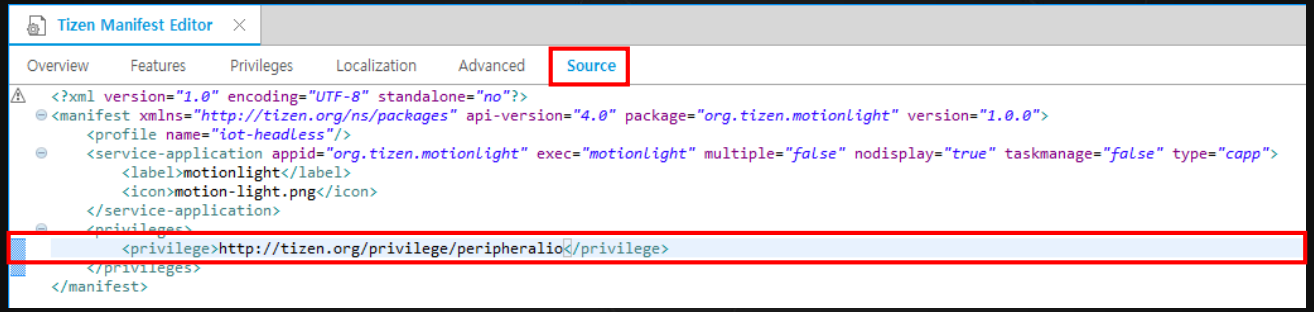
- Custom Privileges 선택 > http://tizen.org/privilege/peripheralio 추가



Motion Light Control: Code Implementation

Peripheral IO API 사용을 위해 peripheralio privilege 추가

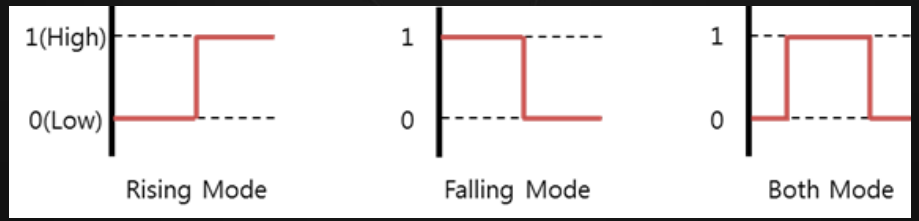
- 파일 저장 후, Source 탭에서 privilege 추가된 것을 재확인



Motion Light Control: Code Implementation

General Purpose Input / Output (GPIO)

- Binary input peripheral 상태 읽기/쓰기 가능한 interface
- Tizen Peripheral IO Native APIs - GPIO 가이드
  https://developer.tizen.org/development/iot-preview/iot-apis/tizen-peripheral-io-native-api/gpio



Motion Light Control: Code Implementation

peripheral_gpio_open()

- 특정 pin 넘버의 Peripheral GPIO 핸들을 열어줌

```
int pin = 26; /* ARTIK 530 : GPIO8, Raspberry Pi 3 : GPIO26 */
peripheral_gpio_h gpio_h;

Int ret = peripheral_gpio_open(pin, &gpio_h);
```

peripheral_gpio_close()

- 더 이상 사용되지 않는 Peripheral GPIO 핸들을 닫아줌

```
peripheral_gpio_close(gpio_h);
```

Motion Light Control: Code Implementation

- **peripheral_gpio_set_direction()**
  - 데이터 전송 방향을 설정함
    - *PERIPHERAL_GPIO_DIRECTION_IN* : 데이터 읽기 모드
    - *PERIPHERAL_GPIO_DIRECTION_OUT_INITIALLY_HIGH* : 데이터 쓰기 모드, 초기값을 high(1)로 설정
    - *PERIPHERAL_GPIO_DIRECTION_OUT_INITIALLY_LOW* : 데이터 쓰기 모드, 초기값을 low(0)로 설정

```
peripheral_gpio_set_direction(gpio_h, PERIPHERAL_GPIO_DIRECTION_OUT_INITIALLY_LOW);
```

Motion Light Control: Code Implementation

peripheral_gpio_read()

- Peripheral 핸들로부터 binary 데이터 값을 읽어옴

```
uint32_t value;

peripheral_gpio_read(gpio_h, &value);
```

peripheral_gpio_write()

- Peripheral 핸들에 binary 데이터 값을 입력함

```
uint32_t value = 1;

peripheral_gpio_write(gpio_h, value);
```

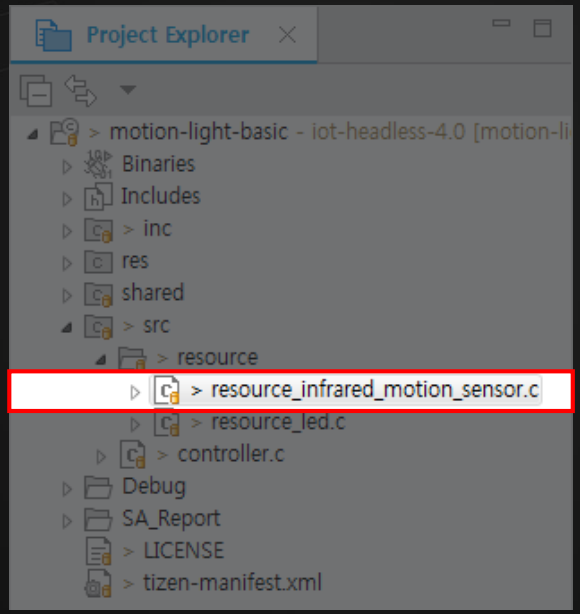
Motion Light Control: Code Implementation

GPIO Pin Number for Eagleye Board

Pin Order	Pin Param	Pin Order	GPIO Param
11	28	29	27
13	29	31	25
16	130	32	0
18	46	33	26
26	14		

Motion Light Control: Code Implementation

- src/resource/resource_infrared_motion_sensor.c



Motion Light Control: Code Implementation

resource_read_infrared_motion_sensor() 함수 내 GPIO 설정 확인 (1)

```
int resource_read_infrared_motion_sensor(int pin_num, uint32_t *out_value)
{
    int ret = PERIPHERAL_ERROR_NONE;

    if (!g_sensor_h) {
        peripheral_gpio_h temp = NULL;

        ret = peripheral_gpio_open(pin_num, &temp);          모션 센서가 연결된 특정 pin 넘버의 Peripheral GPIO 핸들 열기
        retv_if(ret, -1);
                                                             데이터 전송 방향 설정 (읽기 모드)
        ret = peripheral_gpio_set_direction(temp, PERIPHERAL_GPIO_DIRECTION_IN);
        if (ret) {
            peripheral_gpio_close(temp);                     방향 설정 실패 시 열어둔 GPIO 핸들 닫기
            _E("peripheral_gpio_set_direction failed.");
            return -1;
        }

        g_sensor_h = temp;
        g_pin_num = pin_num;
    }
    ...
```

Motion Light Control: Code Implementation

resource_read_infrared_motion_sensor() 함수 내 GPIO 설정 확인 (2)

```
int resource_read_infrared_motion_sensor(int pin_num, uint32_t *out_value)
{
    ...

    if (g_pin_num != pin_num) {
        _E("Invalid pin number.");
        return -1;
    }

    ret = peripheral_gpio_read(g_sensor_h, out_value);
    retv_if(ret < 0, -1);

    return 0;
}
```

GPIO 핸들을 통해 motion값 읽어오기

Motion Light Control: Code Implementation

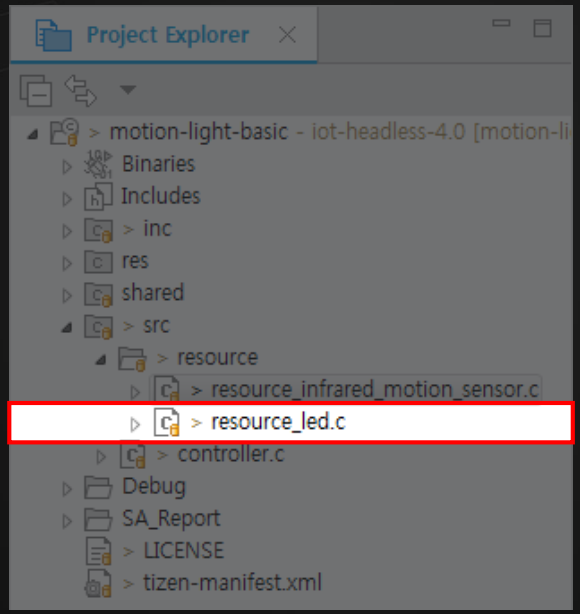
resource_close_infrared_motion_sensor() 함수 내 GPIO 설정 확인

```
void resource_close_infrared_motion_sensor(void)
{
    if (!g_sensor_h) return;

    _I("Infrared Motion Sensor is finishing...");

    peripheral_gpio_close(g_sensor_h);

    g_sensor_h = NULL;
    g_pin_num = -1;
}
```

모션 센서가 연결된 Peripheral GPIO 핸들 닫기

LED Light Control: Code Implementation

- src/resource/resource_led.c



Motion Light Control: Code Implementation

resource_write_led() 함수 내 GPIO 설정 확인 (1)

```
int resource_write_led(int pin_num, int write_value)
{
    int ret = PERIPHERAL_ERROR_NONE;

    if (!g_sensor_h) {
        peripheral_gpio_h temp = NULL;

        ret = peripheral_gpio_open(pin_num, &temp);
        retv_if(ret, -1);

        ret = peripheral_gpio_set_direction(temp, PERIPHERAL_GPIO_DIRECTION_OUT_INITIALLY_LOW);
        if (ret) {
            peripheral_gpio_close(temp);
            _E("peripheral_gpio_set_direction failed.");
            return -1;
        }

        g_sensor_h = temp;
        g_pin_num = pin_num;
    }
    ...
```

LED가 연결된 특정 pin 넘버의 Peripheral GPIO 핸들 열기

데이터 전송 방향 설정 (쓰기 모드)

방향 설정 실패 시 열어둔 GPIO 핸들 닫기

Motion Light Control: Code Implementation

resource_write_led() 함수 내 GPIO 설정 확인 (2)

```
int resource_write_led(int pin_num, int write_value)
{
    ...

    if (g_pin_num != pin_num) {
        _E("Invalid pin number.");
        return -1;
    }

    ret = peripheral_gpio_write(g_sensor_h, write_value);
    retv_if(ret < 0, -1);

    _I("LED Value : %s", write_value ? "ON":"OFF");

    return 0;
}
```

GPIO 핸들을 통해 LED값 설정하기

Motion Light Control: Code Implementation

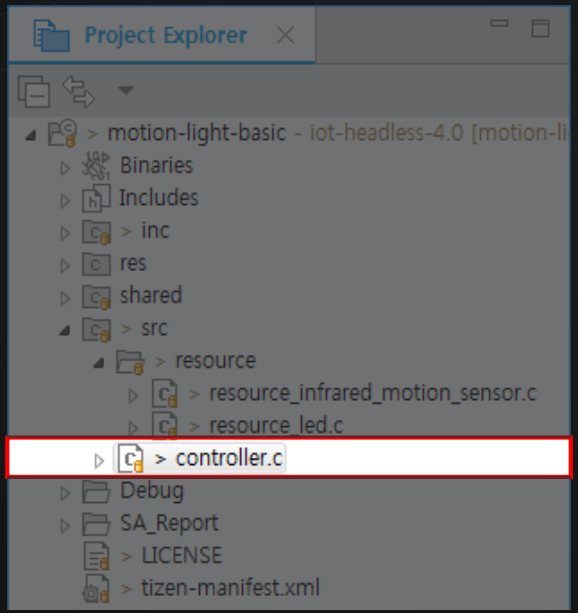
resource_close_led() 함수 내 GPIO 설정 확인

```
void resource_close_led(void)
{
    if (!g_sensor_h) return;

    _I("LED is finishing...");

    peripheral_gpio_close(g_sensor_h);

    g_sensor_h = NULL;
    g_pin_num = -1;
}
```

LED가 연결된 Peripheral GPIO 핸들 닫기

Motion Detection: Code Implementation

- src/controller.c



Motion Light Control: Code Implementation

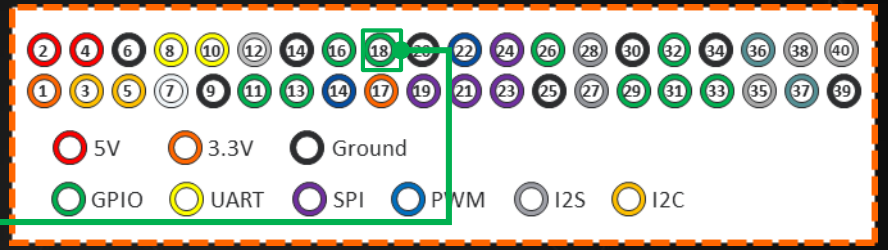
Motion Sensor 값 읽어오기

- 모션 센서가 연결된 특정 Pin에 접근하여 값을 읽어와 value에 저장

```
static Eina_Bool __read_motion_write_led(void *data)
{
    uint32_t value = 0;
    int ret = -1;

    /* Gets value from motion sensor */
    // TODO: Read data from motion sensor
    ret = resource_read_infrared_motion_sensor(SENSOR_MOTION_PIN_NUM, &value);   모션 센서 읽기 함수 호출

    if (ret != 0) _E("Cannot read sensor value");

    _D("Detected motion value is: %d", value);
    ...
}
```

Motion Light Control: Code Implementation

Output



GPIO Pin	Pin Number	GPIO Pin	Pin Number
GPIO 11	28	GPIO 29	27
GPIO 13	29	GPIO 31	25
GPIO 16	130	GPIO 32	0
GPIO 18	46	GPIO 33	26
GPIO 26	14		

Motion Light Control: Code Implementation

Motion Sensor 값 읽어오기

- 모션 센서가 연결된 특정 Pin에 접근하여 값을 읽어와 value에 저장

```
static Eina_Bool __read_motion_write_led(void *data)
{
    uint32_t value = 0;
    int ret = -1;

    /* Gets value from motion sensor */
    // TODO: Read data from motion sensor
    ret = resource_read_infrared_motion_sensor(46, &value);

    if (ret != 0) _E("Cannot read sensor value");

    _D("Detected motion value is: %d", value);
    ...
}
```

모션 센서 읽기 함수 호출

46번 Pin에 접근하여 값을 읽어오도록 설정

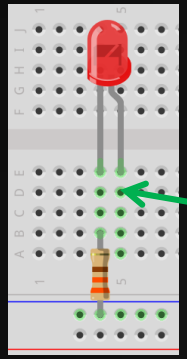
LED Light Control: Code Implementation

LED 값 변경하기

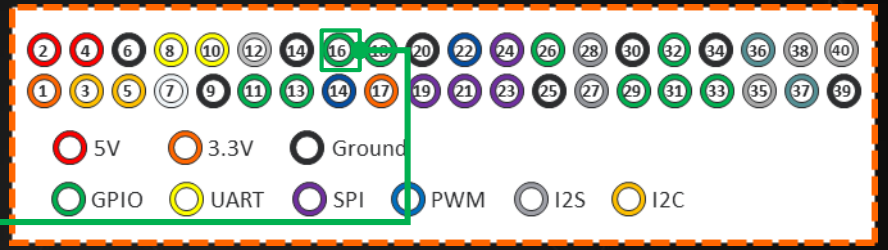
- LED가 연결된 특정 Pin에 접근하여 value 값을 전달

```
static Eina_Bool control_sensors_cb(void *data)
{
    ...

    /* Sends value to LED light */
    // TODO: Send data to LED sensor
    resource_write_led(SENSOR_LED_PIN_NUM, value);                    LED 쓰기 함수 호출

    return ECORE_CALLBACK_RENEW;
}
```

Motion Light Control: Code Implementation



Input



GPIO Pin	Pin Number	GPIO Pin	Pin Number
GPIO 11	28	GPIO 29	27
GPIO 13	29	GPIO 31	25
GPIO 16	130	GPIO 32	0
GPIO 18	46	GPIO 33	26
GPIO 26	14		

LED Light Control: Code Implementation

LED 값 변경하기

- LED가 연결된 특정 Pin에 접근하여 value 값을 전달

```
static Eina_Bool control_sensors_cb(void *data)
{
    ...

    /* Sends value to LED light */
    // TODO: Send data to LED sensor
    resource_write_led(130, value);                    LED 쓰기 함수 호출

    return ECORE_CALLBACK_RENEW;
}
```

130번 Pin에 접근하여 값을 쓰도록 설정

Motion Light Control: Code Implementation

service_app_create() 함수 내 타이머 생성

- 특정 주기마다 모션 센서 값을 불러오고 LED 값을 설정해주는 **__read_motion_write_led** 함수 호출

```
static bool service_app_create(void *data)
{
    ...

    ad->getter_timer = ecore_timer_add(1.0f, __read_motion_write_led, ad);
    if (!ad->getter_timer) {
        _E("Failed to add infrared motion getter timer");
        return false;
    }
    ...
}
```

타이머 생성

주기는 1초(1.0f)로 설정

Motion Light Control: Code Implementation

service_app_terminate() 함수 내 리소스 정리

- App 종료 시, 사용하던 리소스 정리

```
static void service_app_terminate(void *data)
{
    app_data *ad = (app_data *)data;

    // TODO: Delete timer
    if (ad->getter_timer)
        ecore_timer_del(ad->getter_timer);

    // TODO: Close infrared motion & led resources
    resource_close_infrared_motion_sensor();
    resource_close_led();

    // TODO: Free data resource
    free(ad);
}
```

타이머 삭제

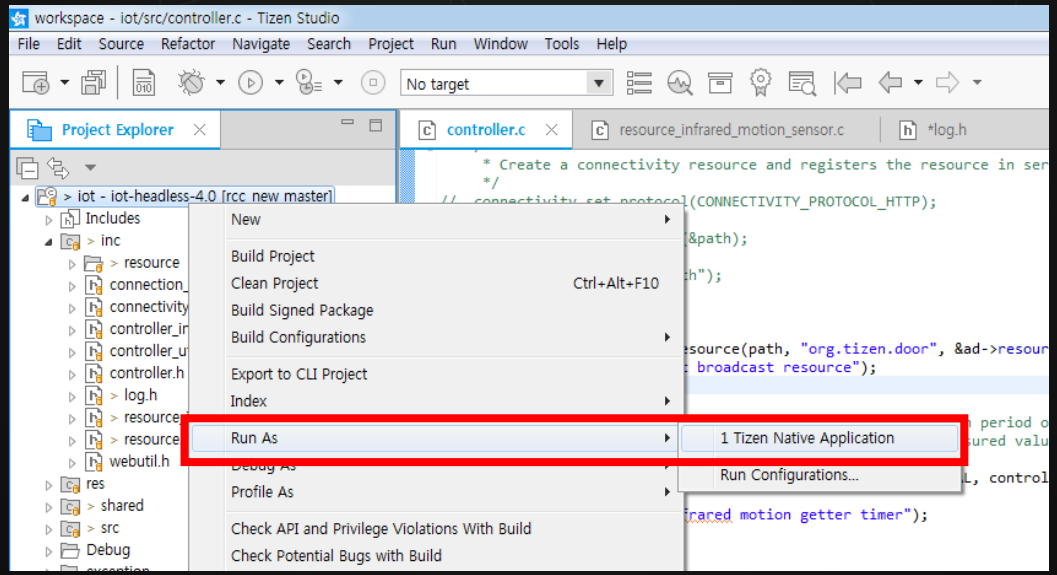
리소스 종료 함수 호출

데이터 리소스 해제

Motion Light Control: Code Implementation

Tizen App 실행

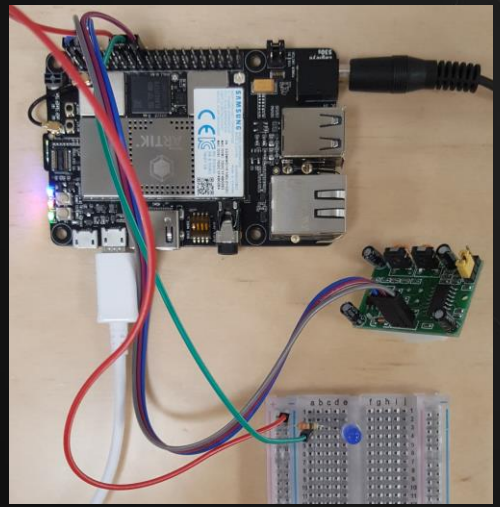
- Project Explorer 내 프로젝트 우클릭 > Run As > Tizen Native App

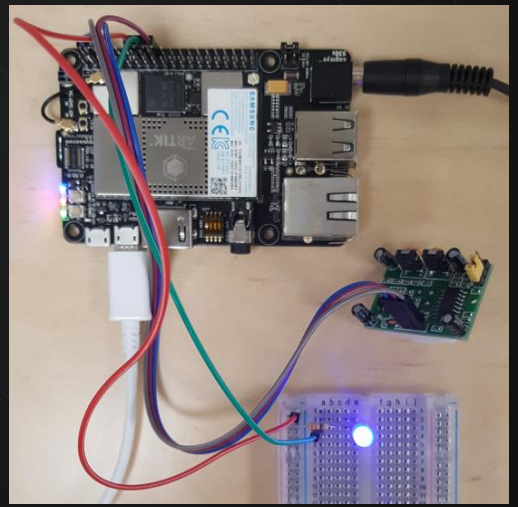


LED Light Control: Code Implementation

Motion - LED Light 확인

- Motion sensor 값에 따른 LED Light 변화 확인





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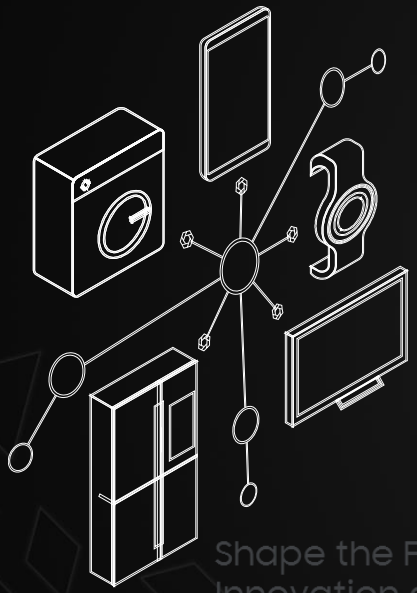


Shape the Future with
Innovation and Intelligence

Ⅲ SmartThings App

Overview

SmartThings

SmartThings

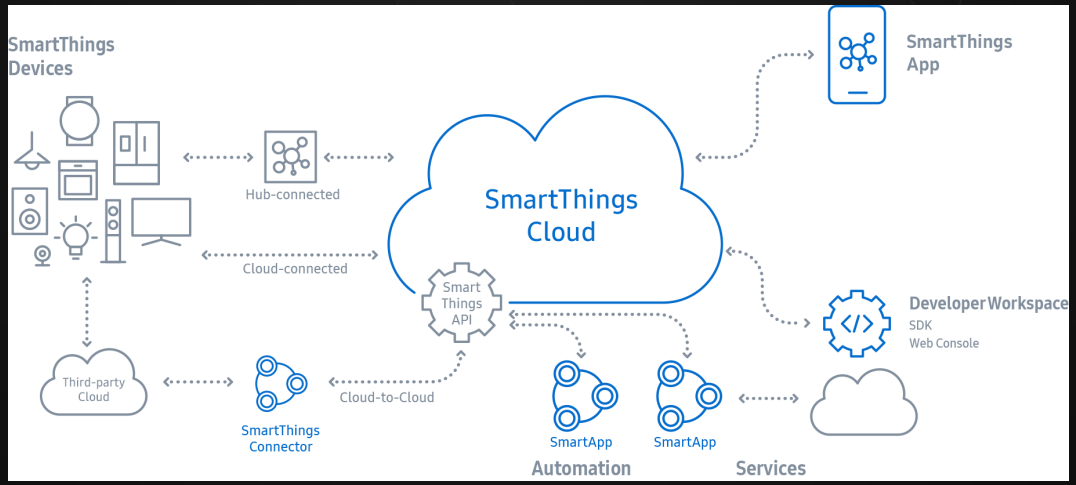
- SmartThings 앱으로 스마트 디바이스를 연결하여 관리 및 제어할 수 있도록 제공되는 IoT 플랫폼
- 높은 확장성을 가져 삼성전자의 제품 외에도 다양한 제품군을 지원함
- **타이젠을 통해 보다 쉽게 SmartThings 앱 개발이 가능**

- SmartThings 공식 홈페이지
- SmartThings Developers 홈페이지

SmartThings

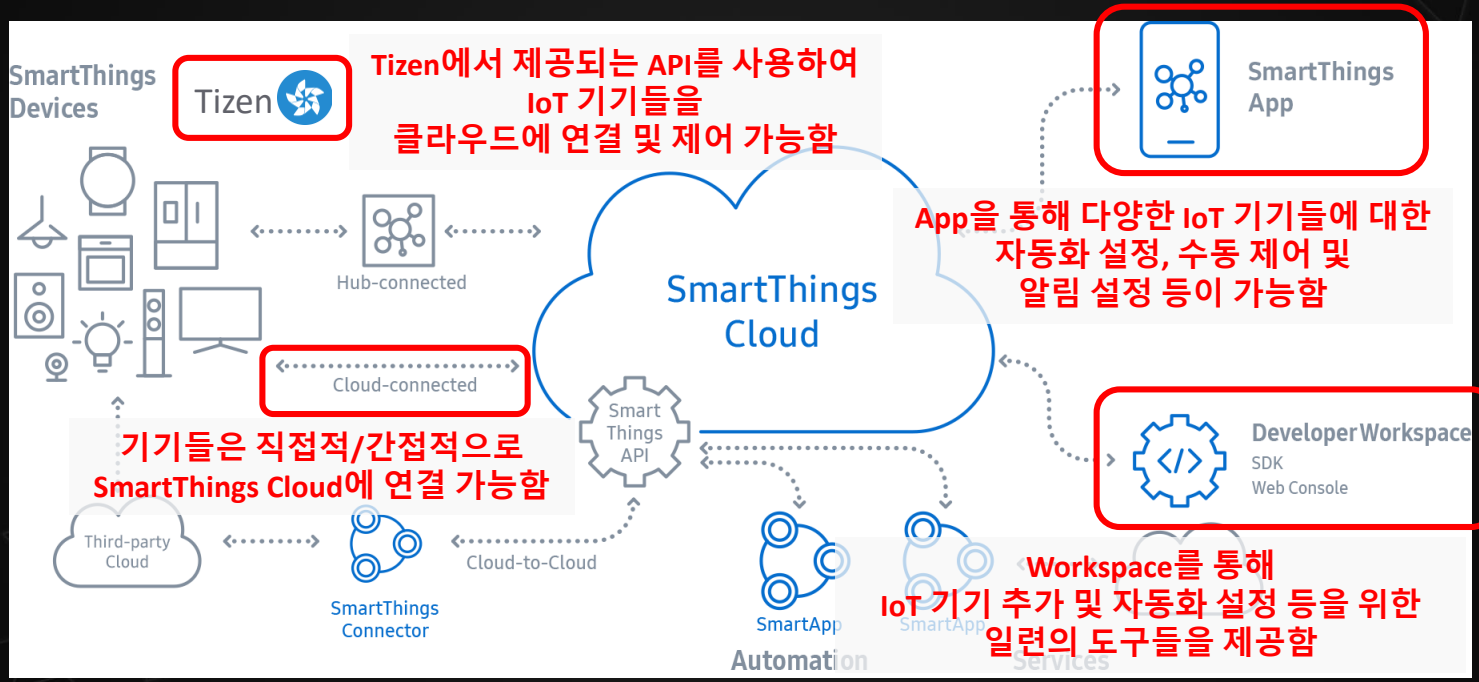
SmartThings Ecosystem

- 다양한 스마트 기기와 SmartThings App 등이 SmartThings Cloud를 통해 서로 연결되고, 제공되는 SmartThings API를 통해 제어 가능



SmartThings

SmartThings Ecosystem



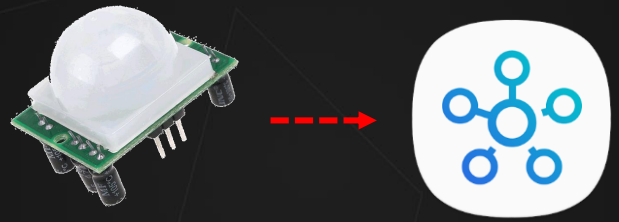
SmartThings

Cloud-connected Device

- Open Connectivity Foundation (OCF) spec의 통신 protocol에 기반하여 SmartThings Cloud와 직접적으로 통신하는 Cloud-connected Tizen App 개발

- Today's SmartThings App

1. 모션 센서에 움직임이 감지되면 SmartThings App을 통해 알림 받기



2. SmartThings App을 통해 LED Light를 on/off 시키기

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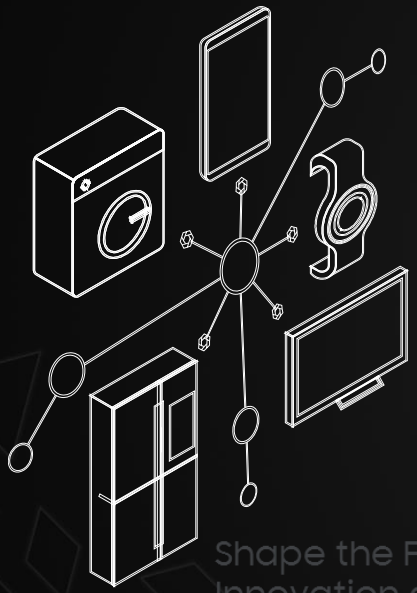

Shape the Future with
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Ⅲ SmartThings App
Developer Workspace

SmartThings: Developer Workspace

Developer Workspace 가입

- https://devworkspace.developer.samsung.com/smartthingsconsole
- 삼성 계정으로 가입 및 로그인

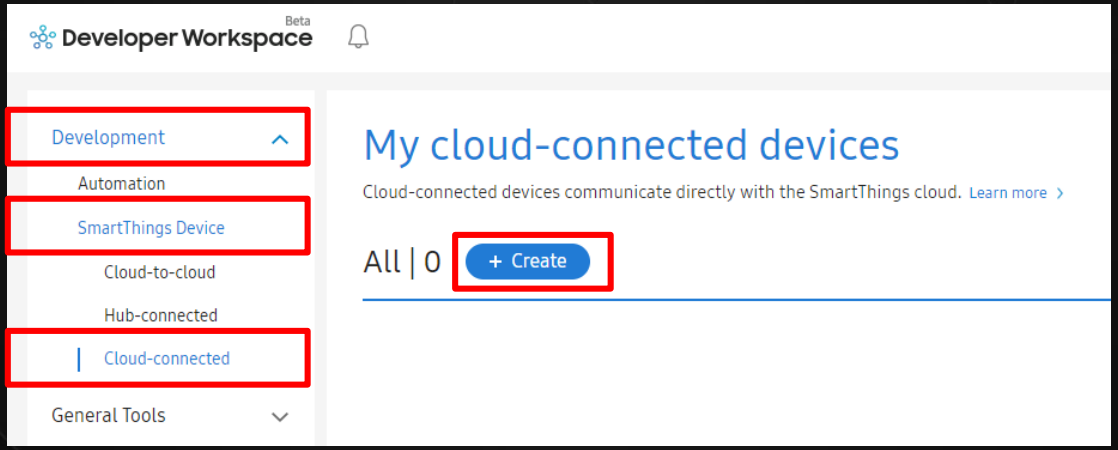
SmartThings App 다운로드

- 안드로이드 모바일 앱 다운로드
- SmartThings (* SmartThings Classic 아님)

SmartThings: Developer Workspace

Cloud-connected 디바이스 생성

- Developer Workspace > Development > SmartThings Device > Cloud-connected > + Create 버튼 클릭



SmartThings: Developer Workspace

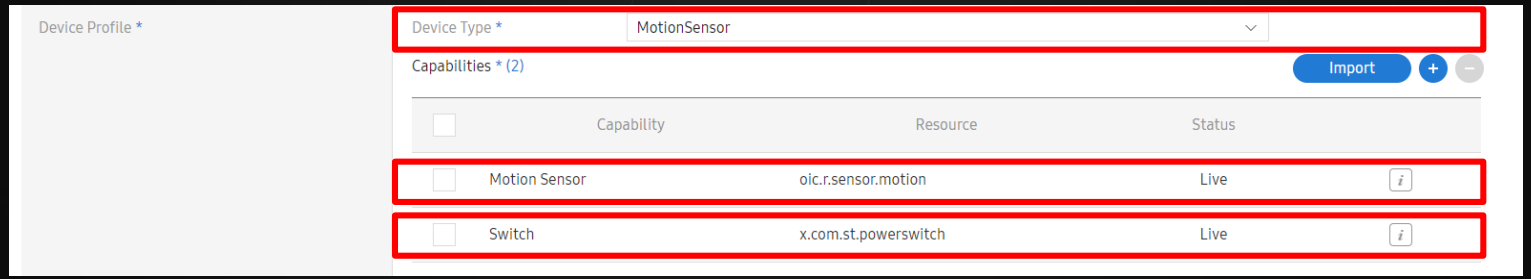
Device Information – 기본 정보 입력

- Device Name 및 VID 정보는 Tizen App의 정보와 같아야 함으로 유의

SmartThings: Developer Workspace

Device Information – Device Profile 입력

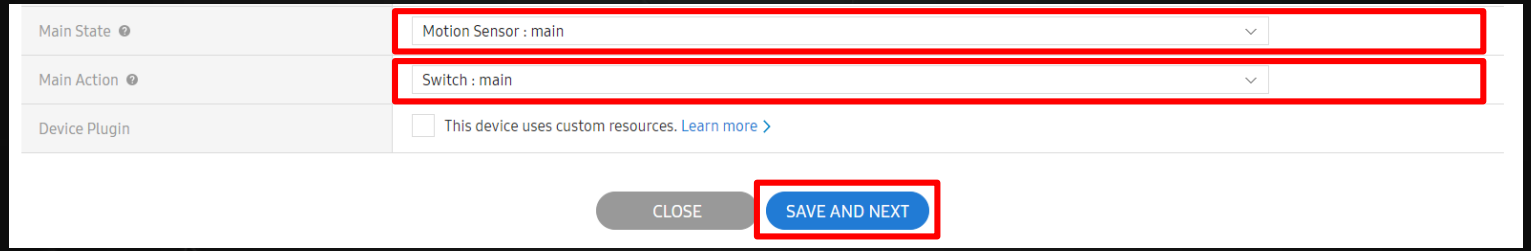
- Sensor에 따라 device type과 필요한 capabilities 선택
  - Device Type: MotionSensor
  - Capabilities: Motion Sensor & Switch



SmartThings: Developer Workspace

Device Information – Main State & Action 설정

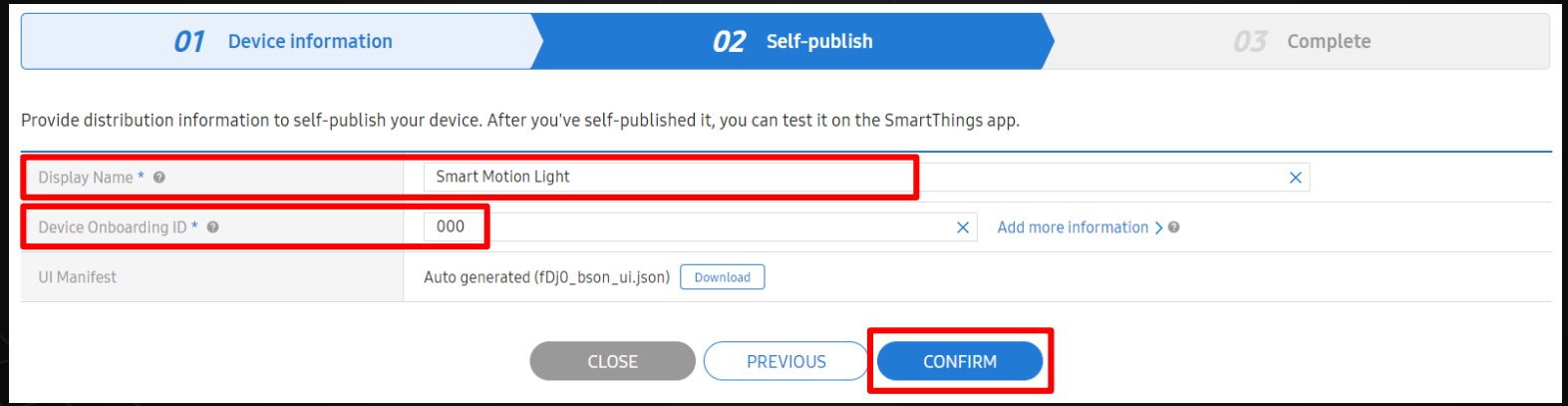
- SmartThings App 메인 화면에 표시될 State와 Action 설정
  - Main State: Motion Sensor : main
  - Main Action: Switch : main
  - App의 UI 변경이 필요하다면 Custom Device Plugin 사용



SmartThings: Developer Workspace

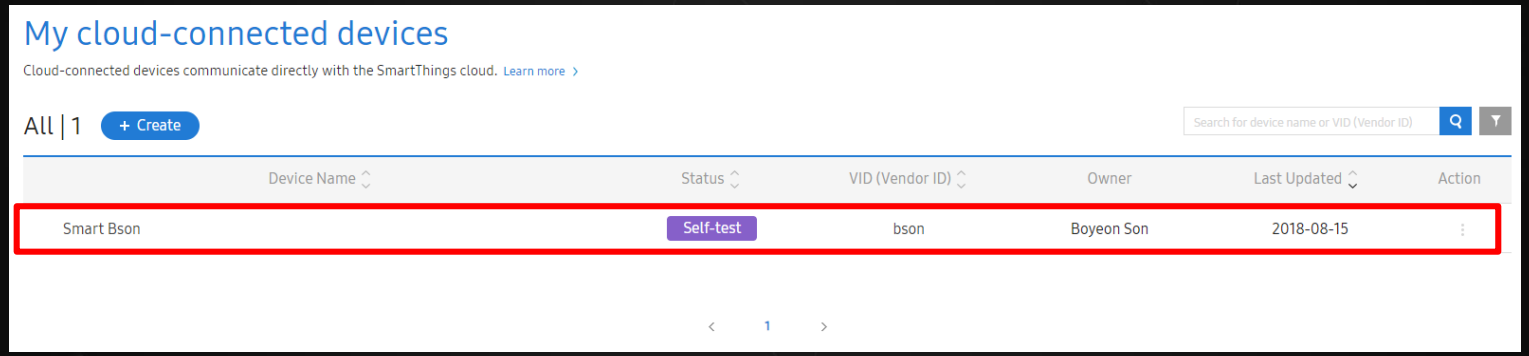
Self-publish

- Display Name: 연결 시 표시 될 디바이스 이름
- Device Onboarding ID: SmartThings App과의 easy setup 시 디바이스의 soft AP 이름에 사용될 임의의 숫자 3개



SmartThings: Developer Workspace

- 새로 생성된 디바이스 확인
  - My cloud-connected devices 목록에서 추가된 디바이스 확인



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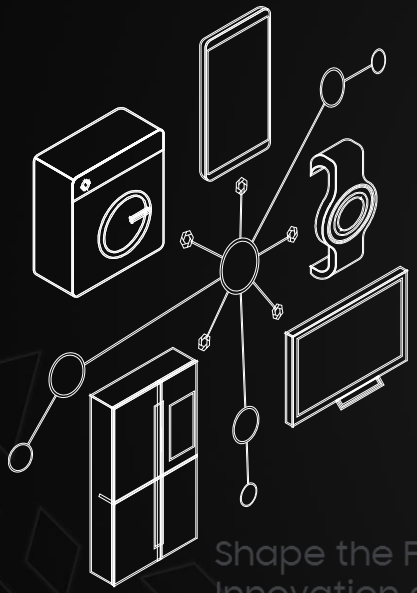


Shape the Future with
Innovation and Intelligence

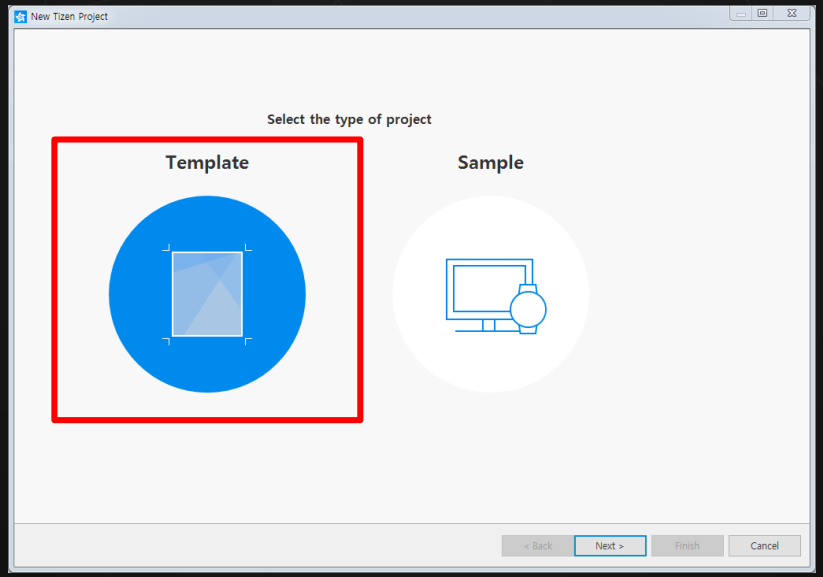
Ⅲ SmartThings App

Tizen Development

SmartThings: Tizen Development

Tizen Studio 내 Headless things App Template 생성

- File > New > Tizen Project > Template 선택

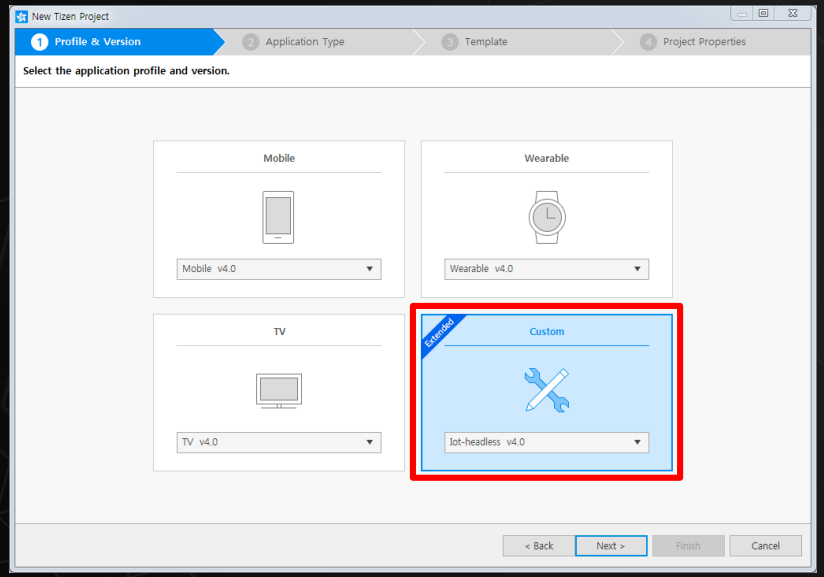


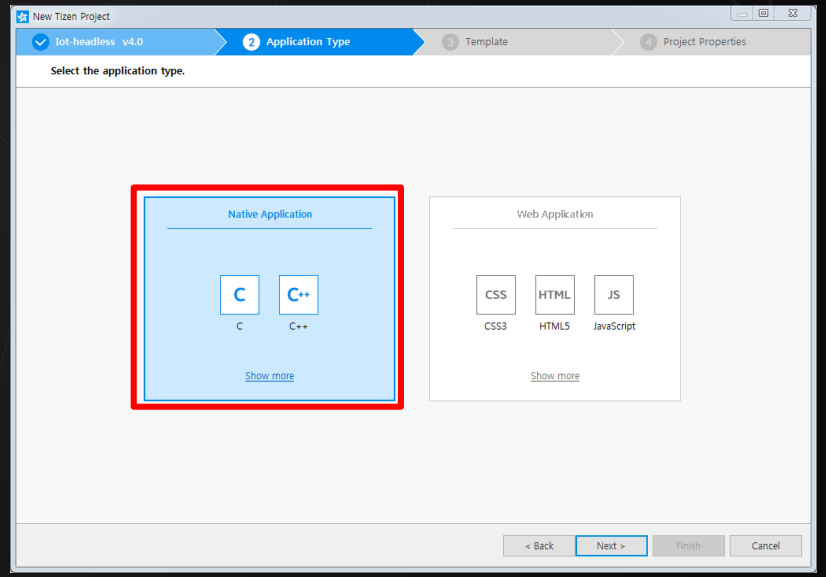
SmartThings: Tizen Development

SAMSUNG Research

Tizen Studio 내 Headless things App Template 생성

- Iot-headless v4.0 선택 > Native Application 선택

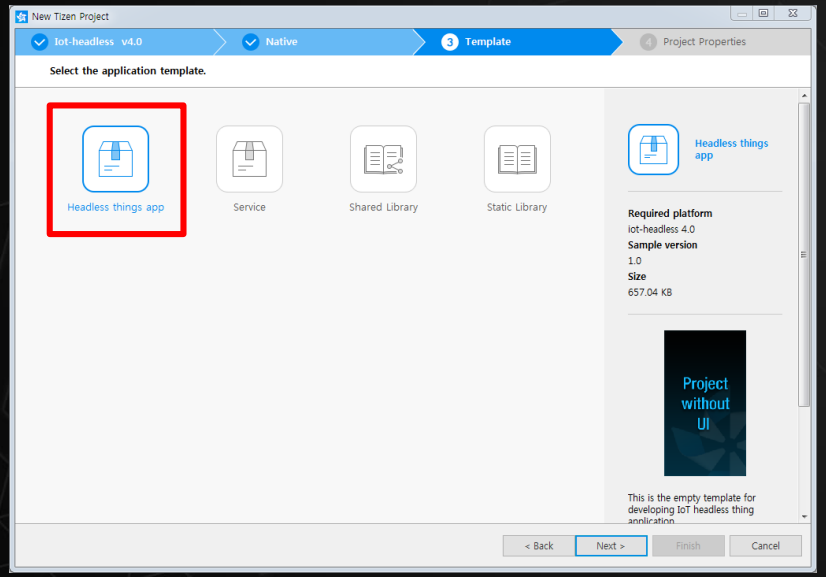


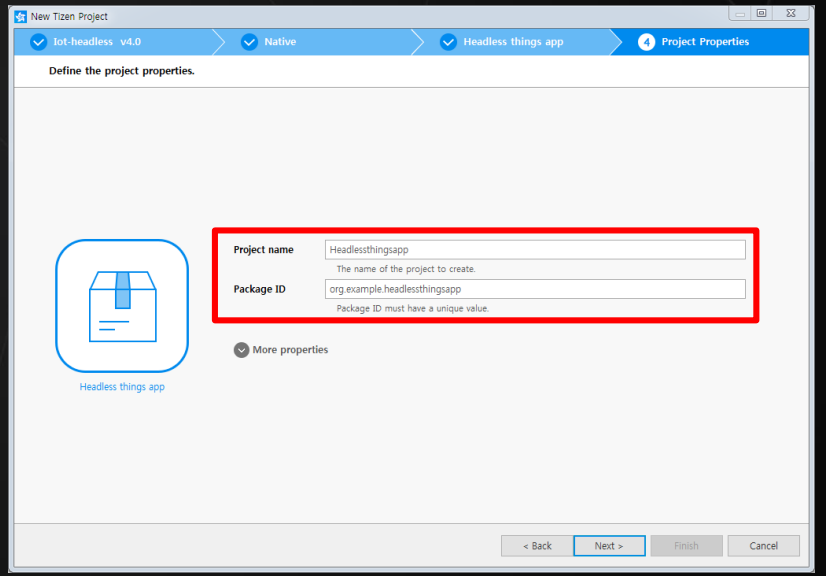


SAMSUNG Research

Tizen Studio 내 Headless things App Template 생성

- Headless things app 선택 > Project Name & Package ID 설정

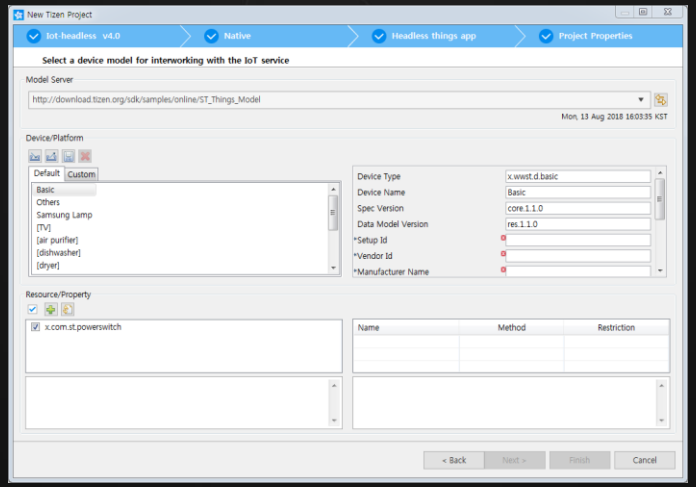




SmartThings: Tizen Development

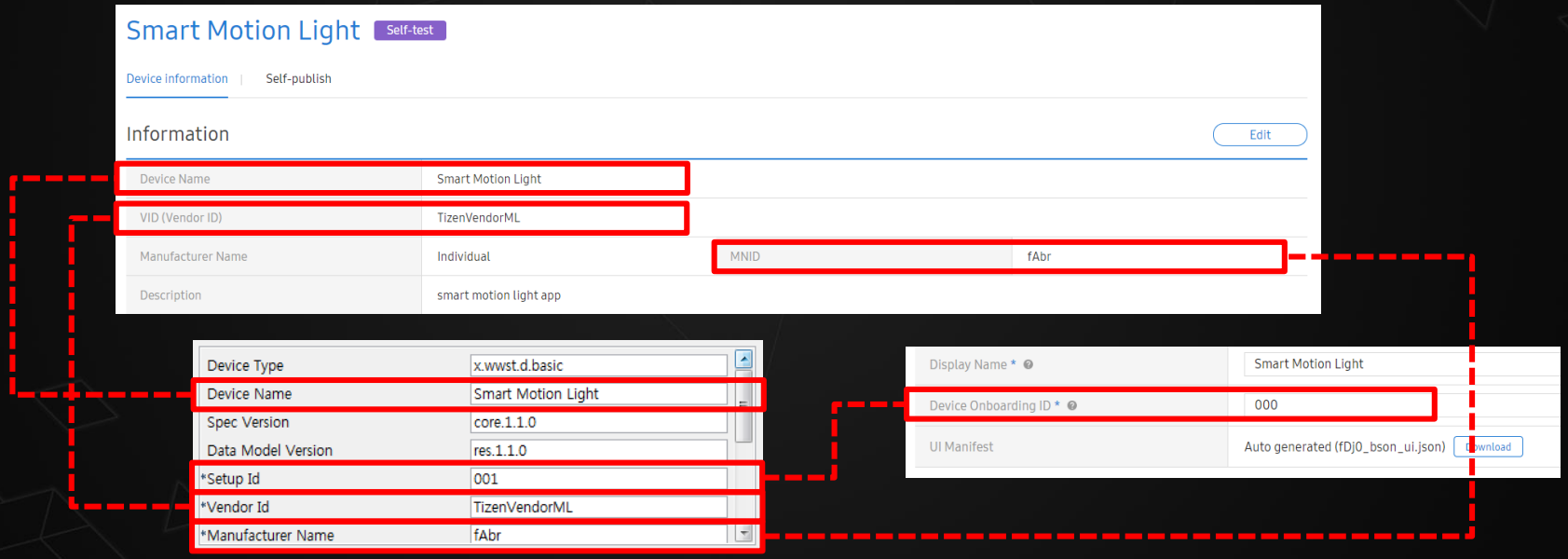
Tizen Studio 내 Headless things App Template 생성

- Device 관련 정보 입력
- Developer Workspace 내 Device 정보와 동일하게 입력



Tizen Studio 내 Headless things App Template 생성

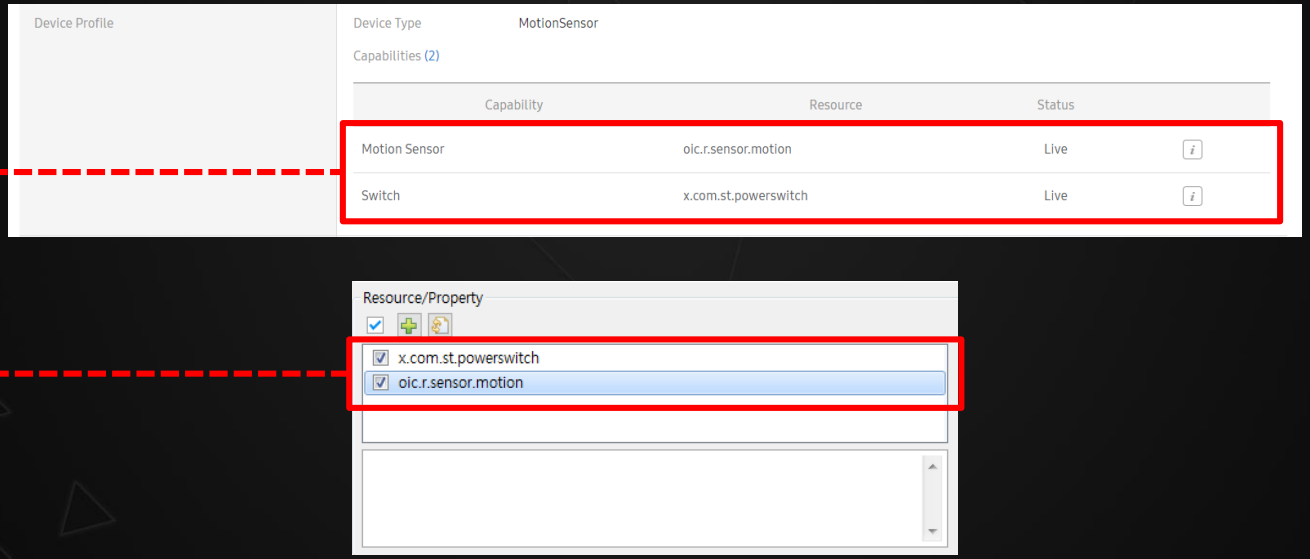
- Developer Workspace 내 Device 정보와 동일하게 입력



SmartThings: Tizen Development

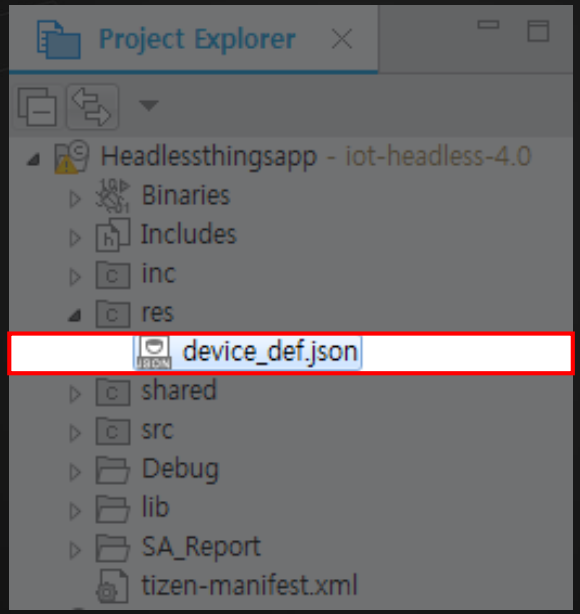
Tizen Studio 내 Headless things App Template 생성

- Developer Workspace 내 Device 정보와 동일하게 입력



SmartThings: Tizen Development

- res/device_def.json



SmartThings: Tizen Development

- device_def.json에서 설정 값 확인

device_def.json

```
{
  "device": [
    {
      "specification": {
        "device": {
          "deviceType": "x.wwst.d.basic",
          "deviceName": "Smart Motion Light",
          "specVersion": "core.1.1.0",
          "dataModelVersion": "res.1.1.0"
        },
        "platform": {
          "manufacturerName": "fAbr",
          "manufacturerUrl": "http://www.samsung.com/sec/",
          "manufacturingDate": "2017-11-29",
          "modelNumber": "NWSP-01",
          "platformVersion": "1.0",
          "osVersion": "1.0",
          "hardwareVersion": "1.0",
          "firmwareVersion": "1.0",
          "vendorId": "TizenVendorML"
        }
      },
      "resources": {
        "single": [
          {
            "uri": "/capability/switch/main/0",
            "types": [
              "x.com.st.powerswitch"
            ],
```

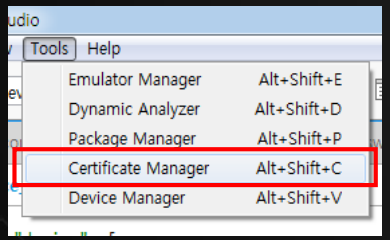
device_def.json

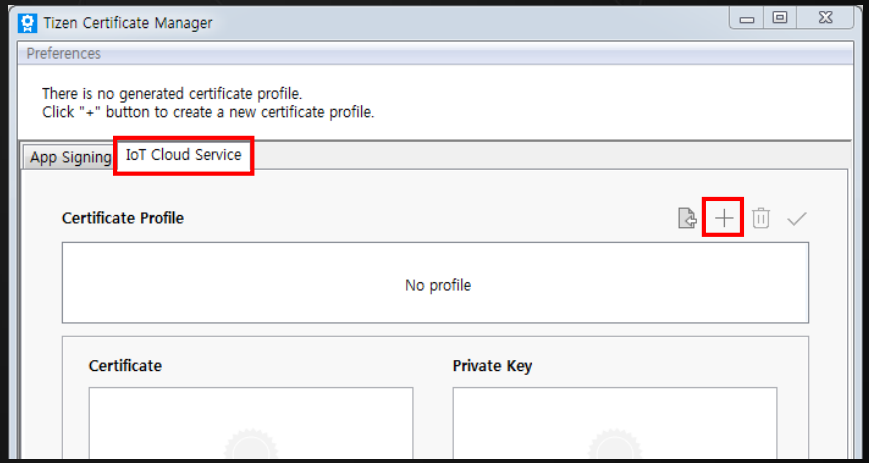
```
      }
    ],
    "resourceTypes": [
      {
        "type": "x.com.st.powerswitch",
        "properties": [
          {
            "key": "power",
            "type": 3,
            "mandatory": true,
            "rw": 3
          }
        ]
      },
      {
        "type": "oic.r.sensor.motion",
        "properties": [
          {
            "key": "value",
            "type": 0,
            "mandatory": false,
            "rw": 1
          }
        ]
      }
    ],
    "configuration": {
      "easySetup": {
        "connectivity": {
```

SmartThings: Tizen Development

IoT Cloud Certificate 생성

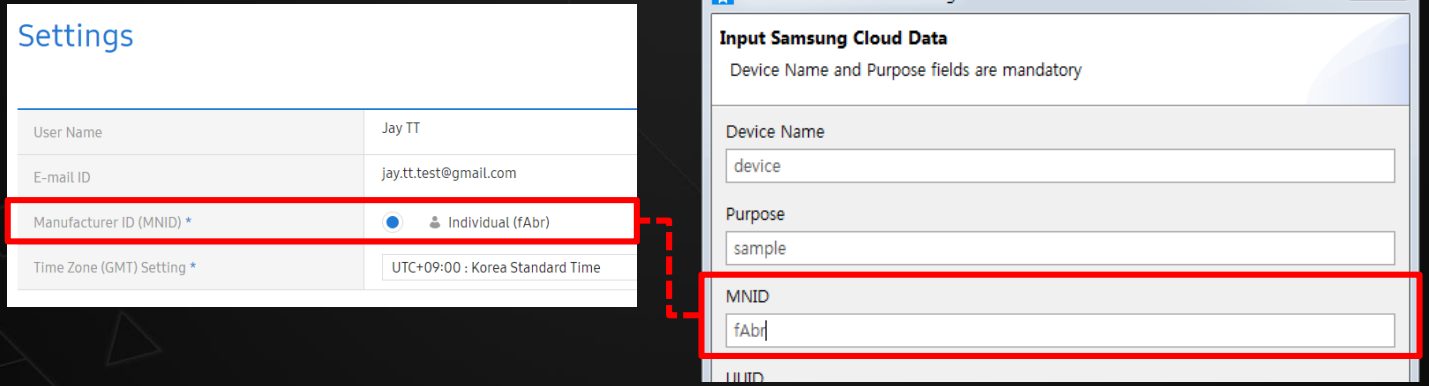
- SmartThings App은 별도의 Iot Cloud용 인증서가 필요
- Tools > Certificate Manager 선택 > IoT Cloud Service 탭 선택





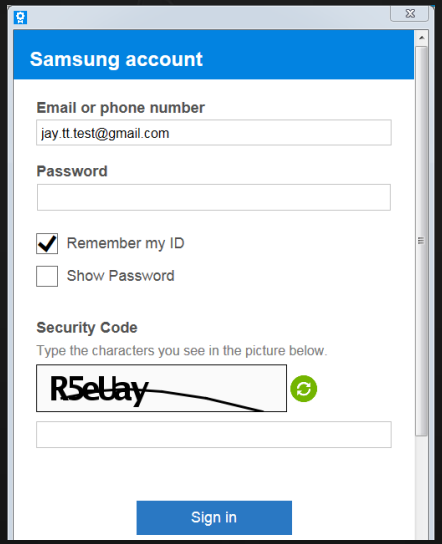
IoT Cloud Certificate 생성

- 개인 정보 입력 / 디바이스 정보 입력
  - MNID는 Developer Workspace의 MNID와 동일해야함으로 유의
  - 본인의 MNID는 Worksapce의 계정 settings에서 확인 가능



IoT Cloud Certificate 생성

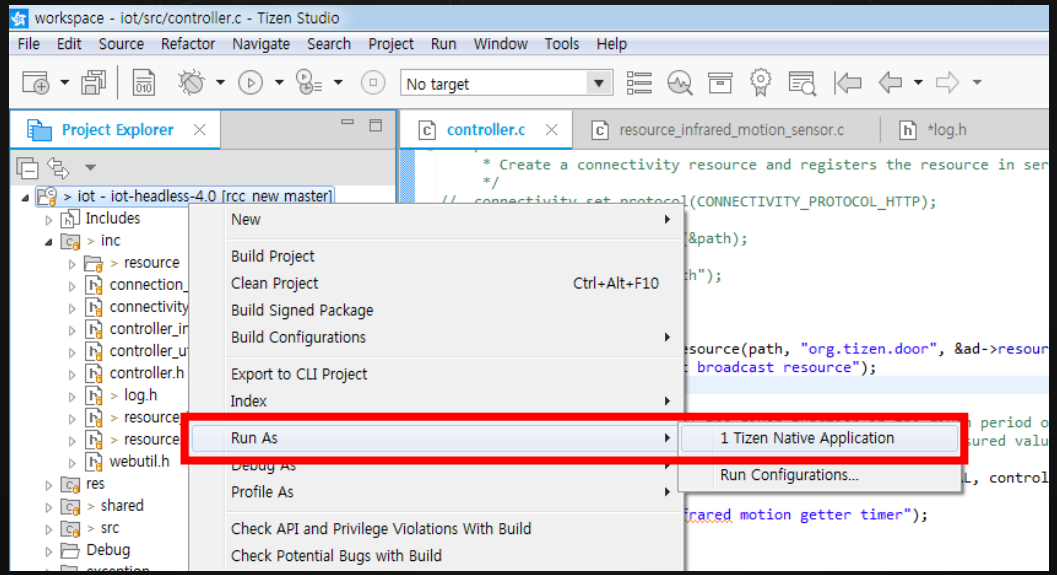
- Developer Workspace에 등록된 Samsung 계정으로 로그인



SmartThings: Tizen Development

Tizen App 실행

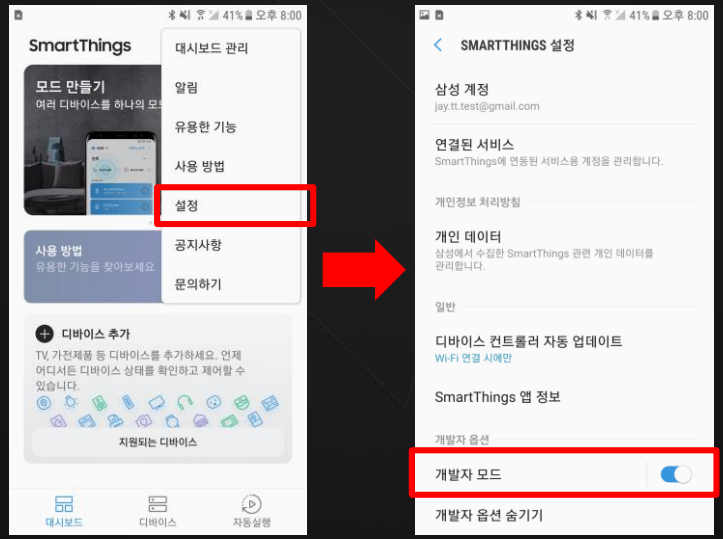
- Project Explorer 내 프로젝트 우클릭 > Run As > Tizen Native App



SmartThings: Easy Setup

SmartThings Mobile App 개발자 모드 설정

- 우측 상단 More(...) 버튼 클릭 > 설정 > 개발자 모드 ON



SmartThings: Easy Setup

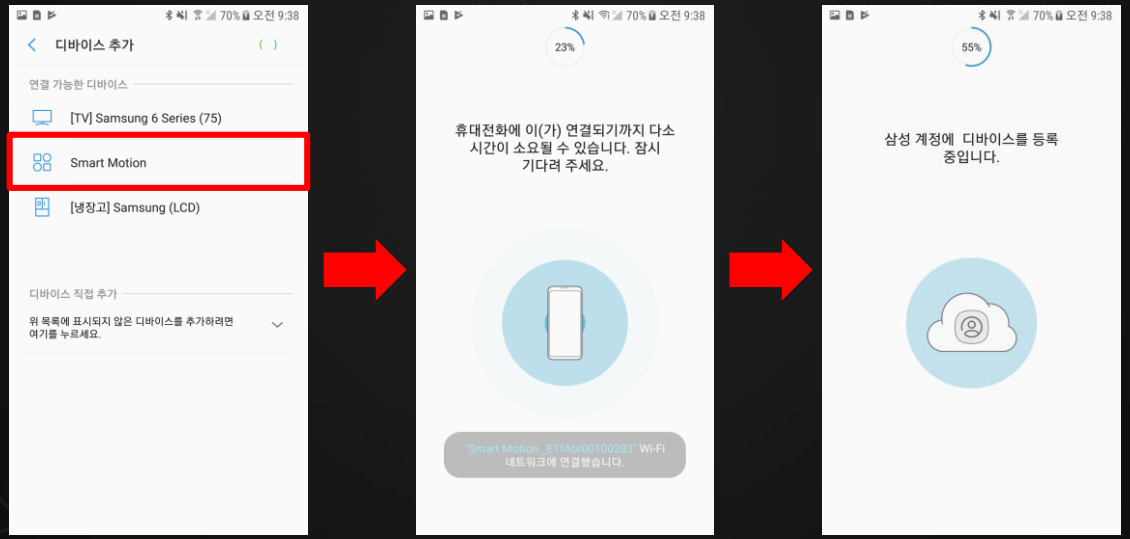
Easy Setup: SmartThings App – Device 연결

- 디바이스 탭 선택 > 디바이스 추가

SmartThings: Easy Setup

Easy Setup: SmartThings App – Device 연결

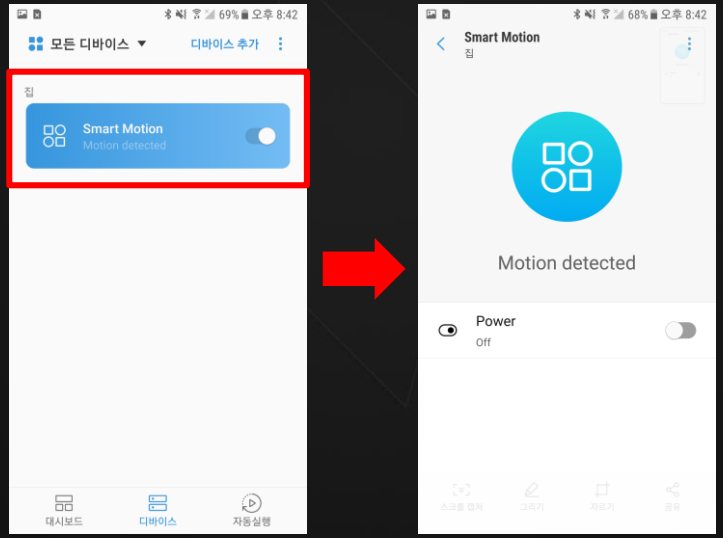
- 본인의 디바이스 선택



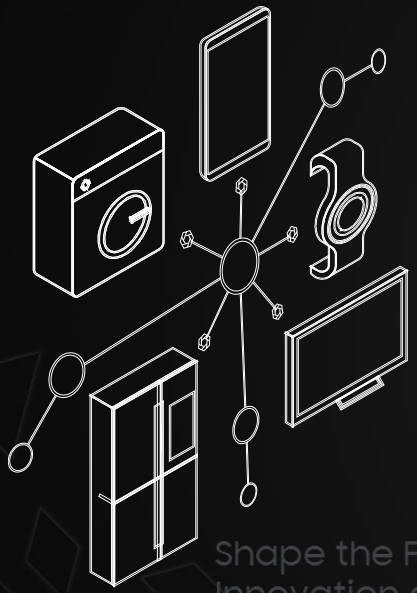
SmartThings: Easy Setup

Easy Setup: SmartThings App – Device 연결

- App UI (Motion 표시창, Power 버튼) 확인



SAMSUNG Research



Shape the Future with
Innovation and Intelligence

Ⅲ SmartThings App
Code Implementation

SmartThings: Code Implementation

- **Tizen에서 제공되는 Things SDK API를 활용**
  - Tizen Things SDK API
    https://developer.tizen.org/development/iot-preview/iot-apis/things-sdk-api
  - Tizen Things SDK API Usage
    https://developer.tizen.org/development/iot-preview/iot-apis/things-sdk-api/api-usage
  - ST Things SDK Documentation
    https://developer.tizen.org/dev-guide/things-sdk/index.html

SmartThings: Code Implementation

디바이스 설정 파일 설정

- 디바이스 설정 파일이 저장되는 경로를 지정

```
int st_things_set_configuration_prefix_path(const char* ro_path, const char* rw_path);
```

디바이스 초기화

- SmartThings와의 연동을 위한 초기화 진행 & easy setup status 확인

```
int st_things_initialize(const char *json_path, bool *easysetup_complete);
```

디바이스 자원 정리

- SmartThings와의 연동이 끝날 때 detinitialize 프로세스 진행

```
int st_things_deinitialize(void);
```

SmartThings: Code Implementation

주요 콜백 등록

- Request Callback: SmartThings 클라우드로부터의 요청 처리
- Reset Callback: 디바이스 초기화 관련 요청 처리
- User Confirm Callback: 상호인증 방식으로 easy setup 진행 처리
- Things Status Change Callback: SmartThings 클라우드와의 연동 과정에서 벌어지는 상태 변화를 확인

```
int st_things_register_request_cb(st_things_get_request_cb get_cb, st_things_set_request_cb set_cb);
int st_things_register_reset_cb(st_things_reset_confirm_cb confirm_cb, st_things_reset_result_cb result_cb);
int st_things_register_user_confirm_cb(st_things_user_confirm_cb confirm_cb);
int st_things_register_reset_cb(st_things_reset_confirm_cb confirm_cb, st_things_reset_result_cb result_cb);
```

SmartThings: Code Implementation

Get Request Callback

- 특정 리소스의 property에 대하여 Get 요청 처리

```
typedef bool (*st_things_get_request_cb)(st_things_get_request_message_s *req_msg,
st_things_representation_s *resp_rep);
```

Set Request Callback

- 특정 리소스의 property에 대하여 Set 요청 처리

```
typedef bool (*st_things_set_request_cb)(st_things_set_request_message_s *req_msg,
st_things_representation_s *resp_rep);
```

SmartThings: Code Implementation

Notifying Observers

- 특정 리소스(센서)에 변동사항이 생기면 클라우드에 알려줌

```
int st_things_notify_observers(const char *resource_uri);
```

클라우드 연동 시작

- SmartThings Cloud와의 연동 시작

```
int st_things_start(void);
```

클라우드 연동 종료

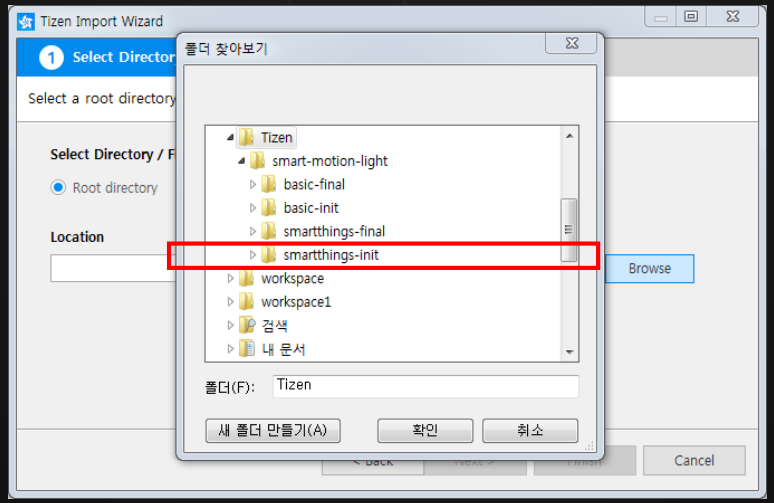
- SmartThings Cloud와의 연동 종료

```
int st_things_stop(void);
```

SmartThings: Code Implementation

Tizen Studio에서 motion-light-smartthings 프로젝트 불러오기

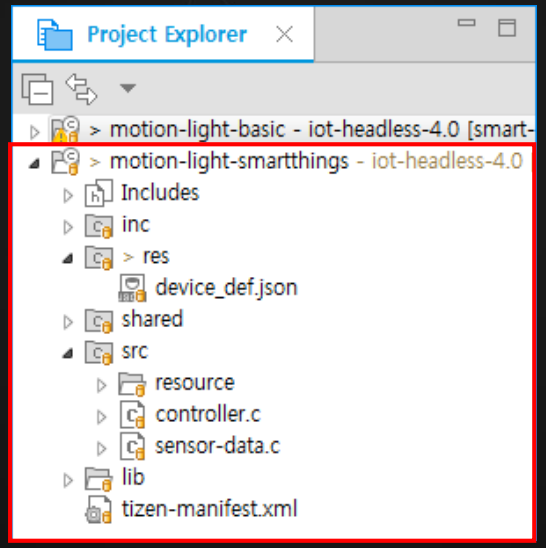
- Root directory 선택 > Browse 클릭
- smart-motion-light/smartthings-init 폴더 선택



SmartThings: Code Implementation

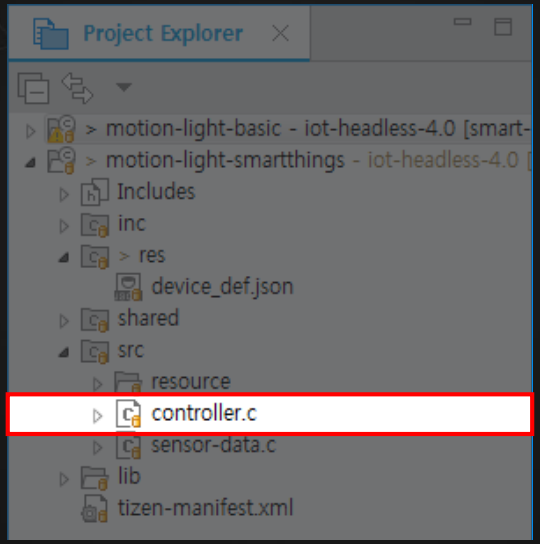
Tizen Studio에서 motion-light-smartthings 프로젝트 불러오기

- Project Explorer에서 motion-light-smartthings 프로젝트 확인



SmartThings: Code Implementation

- src/controller.c



SmartThings: Code Implementation

SmartThings API 사용 시 필요한 Macro 값 확인

device_def.json

```
"resources": {
  "single": [
    {
      "uri": "/capability/switch/main/0",
      "types": [
        "x.com.st.powerswitch"
      ],
      "interfaces": [
        "oic.if.a",
        "oic.if.baseline"
      ],
      "policy": 3
    },
    {
      "uri": "/capability/motionSensor/main/0",
      "types": [
        "oic.r.sensor.motion"
      ],
      "interfaces": [
        "oic.if.s",
        "oic.if.baseline"
      ],
      "policy": 3
```

```
#define JSON_NAME "device_def.json"
#define SENSOR_MOTION_URI "/capability/motionSensor/main/0"
#define SENSOR_MOTION_KEY "value"
#define SENSOR_LED_URI "/capability/switch/main/0"
#define SENSOR_LED_KEY "power"
#define SENSOR_LED_INIT "off"
```

SmartThings: Code Implementation

SmartThings API 사용 시 필요한 Macro 값 확인

device_def.json

```
    }
  ],
  "resourceTypes": [
    {
      "type": "x.com.st.powerswitch",
      "properties": [
        {
          "key": "power",
          "type": 3,
          "mandatory": true,
          "rw": 3
        }
      ]
    },
    {
      "type": "oic.r.sensor.motion",
      "properties": [
        {
          "key": "value",
          "type": 0,
          "mandatory": false,
          "rw": 1
        }
      ]
    }
```

```
#define JSON_NAME "device_def.json"
#define SENSOR_MOTION_URI "/capability/motionSensor/main/0"
#define SENSOR_MOTION_KEY "value"
#define SENSOR_LED_URI "/capability/switch/main/0"
#define SENSOR_LED_KEY "power"
#define SENSOR_LED_INIT "off"
```

SmartThings: Code Implementation

__thing_init() 함수 내 디바이스 초기화

- 디바이스 설정 파일이 저장되는 경로를 지정

```
static int __things_init(void)
{
  ...
  app_res_path = app_get_resource_path();
  ...

  app_data_path = app_get_data_path();
  ...

  // TODO: Specify the read-only and read-write path
  if (0 != st_things_set_configuration_prefix_path(app_res_path, app_data_path)) {
    _E("st_things_set_configuration_prefix_path() failed!!");
    free(app_res_path);
    free(app_data_path);
    return -1;
  }
  ...
}
```

read-only 파일을 저장할 경로 (app_res_path) 및
read-write 파일을 저장할 경로 (app_data_path) 지정

SmartThings: Code Implementation

__thing_init() 함수 내 디바이스 초기화

- SmartThings와의 연동을 위한 초기화 진행

```
static int __things_init(void)
{
  bool easysetup_complete = false;
  ...

  // TODO: Specify the device configuration JSON file and change the status of easysetup_complete
  if (0 != st_things_initialize(app_json_path, &easysetup_complete)) {
    _E("st_things_initialize() failed!!");
    return -1;
  }
  ...
}
```

디바이스와 리소스에 대해 정의하고 있는 JSON 파일의 경로 및 easysetup 완료 여부를 확인할 수 있는 boolean 변수의 주소 지정

SmartThings: Code Implementation

__thing_init() 함수 내 주요 콜백 등록

- request / restet / user_confirm / status_change에 대한 콜백 함수 등록

```
static int __things_init(void)
{
  ...

  // TODO: Register callback for handling request get (handle_get_request) and request set (handle_set_request)
messages
  st_things_register_request_cb(handle_get_request, handle_set_request);
  // TODO: Register callback for reset confirmation (handle_reset_request) and reset result(handle_reset_result)
functions
  st_things_register_reset_cb(handle_reset_request, handle_reset_result);
  // TODO: Register callback for getting user confirmation for ownership transfer (handle_ownership_transfer_request)
  st_things_register_user_confirm_cb(handle_ownership_transfer_request);
  // TODO: Register callback for getting notified when ST Things state changes (handle_things_status_change)
  st_things_register_things_status_change_cb(handle_things_status_change);

  ...
}
```

SmartThings: Code Implementation

handle_get_request()

- Request 메시지의 resource_uri에 따라 get request 처리 함수 호출

```
static bool handle_get_request(st_things_get_request_message_s* req_msg, st_things_representation_s* resp_rep)
{
  ...
  _D("resource_uri [%s]", req_msg->resource_uri);
  retv_if(!g_ad, false);

  if (0 == strcmp(req_msg->resource_uri, SENSOR_MOTION_URI)) {
    _D("query : %s, property: %s", req_msg->query, req_msg->property_key);

    // TODO: Call handle get request function for motion sensor
    ret = __handle_get_request_on_motion(req_msg, resp_rep);
  } else if (0 == strcmp(req_msg->resource_uri, SENSOR_LED_URI)) {
    _D("query : %s, property: %s", req_msg->query, req_msg->property_key);

   // TODO: Call handle get request function for LED
    ret = __handle_get_request_on_led(req_msg, resp_rep);
  }
  ...
}
```

get request 메시지의 resource_uri가 SENSOR_MOTION_URI와 같으면 Motion sensor에 대한 get_request 처리 함수 호출

get request 메시지의 resource_uri가 SENSOR_LED_URI와 같으면 LED에 대한 get_request 처리 함수 호출

SmartThings: Code Implementation

__handle_get_request_on_motion()

- Motion property 관련 데이터 값을 변경

```
static bool __handle_get_request_on_motion (st_things_get_request_message_s* req_msg, st_things_representation_s*
resp_rep)
{
  if (req_msg->has_property_key(req_msg, SENSOR_MOTION_KEY)) {
    bool value = false;

    sensor_data_get_bool(g_ad->motion_data, &value);

    // TODO: Update the response representation about the Sensor property which is sent to the client
    resp_rep->set_bool_value(resp_rep, SENSOR_MOTION_KEY, value);

    _D("Value : %d", value);

    return true;
  } else {
    _E("not supported property");

    return false;
  }
}
```

SmartThings: Code Implementation

__handle_get_request_on_led()

- LED property 관련 데이터 값을 변경

```
static bool __handle_get_request_on_led (st_things_get_request_message_s* req_msg, st_things_representation_s*
resp_rep)
{
  if (req_msg->has_property_key(req_msg, SENSOR_LED_KEY)) {
    const char *str = NULL;

    sensor_data_get_string(g_ad->led_data, &str);

    if (!str) {
      str = SENSOR_LED_INIT;
    }

    // TODO: Update the response representation about the LED property which is sent to the client
    resp_rep->set_str_value(resp_rep, SENSOR_LED_KEY, str);

    ...
  }
  ...
}
```

SmartThings: Code Implementation

handle_set_request()

- Request 메시지의 resource_uri에 따라 set request 처리 함수 호출

```
static bool handle_set_request(st_things_set_request_message_s* req_msg, st_things_representation_s* resp_rep)
{
  bool ret = false;

  _D("resource_uri [%s]", req_msg->resource_uri);
  retv_if(!g_ad, false);

  if (0 == strcmp(req_msg->resource_uri, SENSOR_LED_URI)) {
    // TODO: Call handle set request function for LED
    ret = __handle_set_request_on_led(req_msg, resp_rep);
  } else {
    _E("not supported uri");
  }

  return ret;
}
```

set request 메시지의 resource_uri가 SENSOR_LED_URI와 같으면
LED에 대한 set_request 처리 함수 호출

SmartThings: Code Implementation

__handle_set_request_on_led()

- LED property 관련 데이터 값 변경 및 LED의 상태 변경

```
static bool __handle_set_request_on_led (st_things_set_request_message_s* req_msg, st_things_representation_s*
resp_rep)
{
  int ret = 0;
  char *str = NULL;

  if (req_msg->rep->get_str_value(req_msg->rep, SENSOR_LED_KEY, &str)) {
    ...
    // TODO: Update the response representation about the LED property which is sent to the client
    resp_rep->set_str_value(resp_rep, SENSOR_LED_KEY, str);

    // Turn on LED light with __change_led_data()
    ret = __change_led_data(g_ad, strdup(str));

    retv_if(ret != 0, false);
  } else {
    ...
  }
  ...
}
```

SmartThings: Code Implementation

__change_led_data() 함수 내 notify 설정

- LED 데이터 변경 시, 클라우드에 notify하도록 설정

```
static int __change_led_data(void *data, char *state) {
  ...

  sensor_data_set_string(g_ad->led_data, state, strlen(state));

  if (0 == strcmp(state, LED_ON)) {
    ret = resource_write_led(130, 1);
  } else {
    ret = resource_write_led(130, 0);
  }

  retv_if(ret != 0, -1);

  // TODO: Notify observers of the LED resource
  st_things_notify_observers(SENSOR_LED_URI);

return 0;
}
```

SmartThings: Code Implementation

__change_motion_sensor_data() 함수 내 notify 설정

- Motion sensor 데이터 변경 시, 클라우드에 notify하도록 설정

```
static Eina_Bool __change_motion_sensor_data(void *data)
{
  uint32_t value = 0;

  /* Gets value from motion sensor */
  int ret = resource_read_infrared_motion_sensor(46, &value);

  if (ret != 0) _E("Cannot read sensor value");

  sensor_data_set_bool(g_ad->motion_data, value);

  _D("Detected motion value is: %d", value);

  // TODO: Notify observers of the Sensor motion resource
  st_things_notify_observers(SENSOR_MOTION_URI);

  return ECORE_CALLBACK_RENEW;
}
```

SmartThings: Code Implementation

기존 설치된 app package 삭제

- sdb shell 접속

  Device Manager > 폴더 표시창에서 우클릭 > Open shell 선택
- 설치된 패키지 확인

  pkgcmd -l -t tpk
- 패키지 삭제

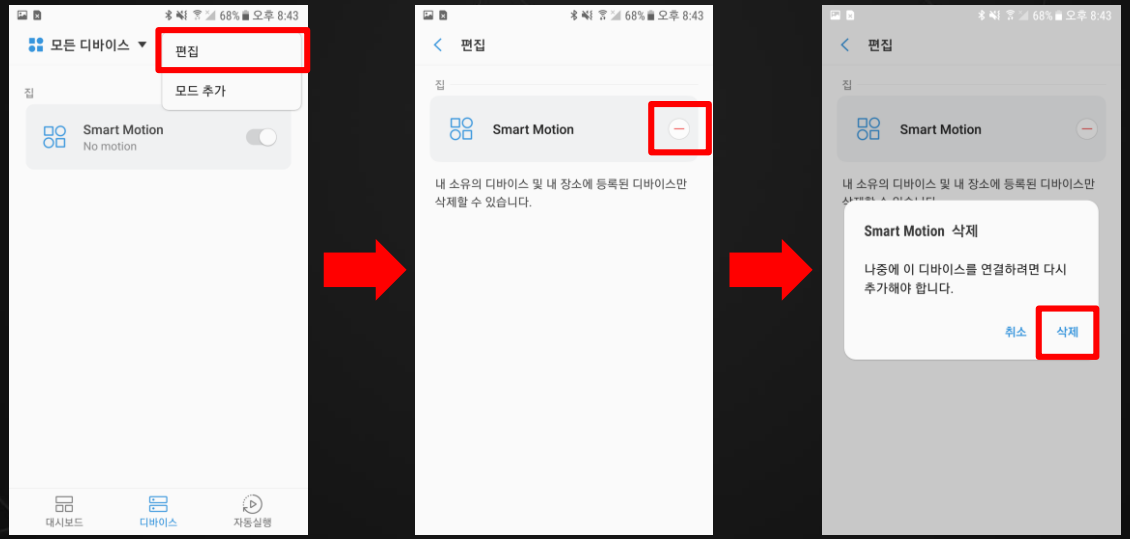
  pkgcmd -u -n org.tizen.motionlight

  pkgcmd -u -n org.example.headlessthingsapp

SmartThings: Code Implementation

⭘ 기존 연결된 디바이스 삭제

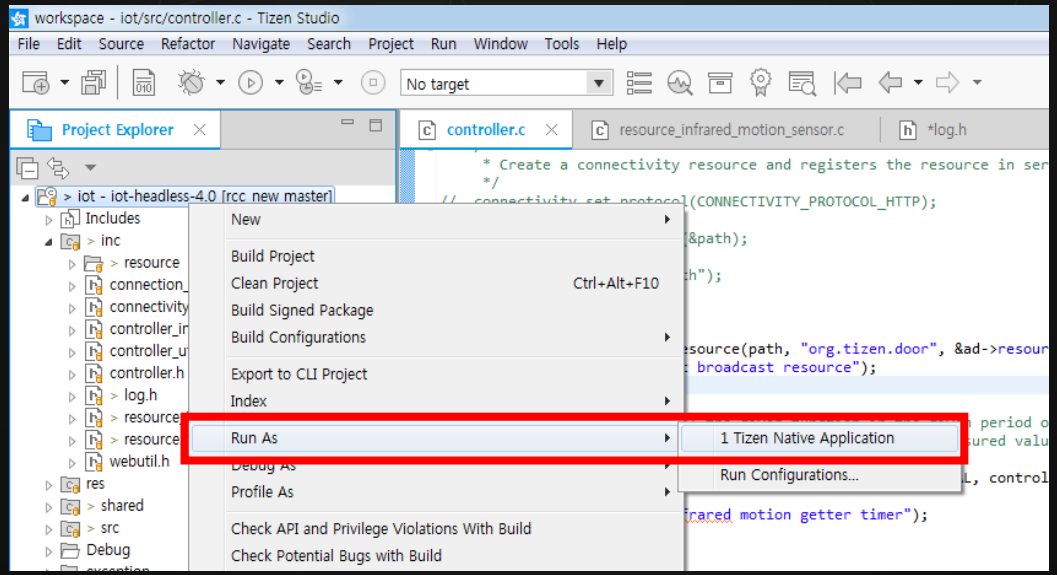
- 우측 상단 More(...) 버튼 클릭 > 편집 > 삭제(-) 버튼 클릭 > 삭제



SmartThings: Code Implementation

Tizen App 실행

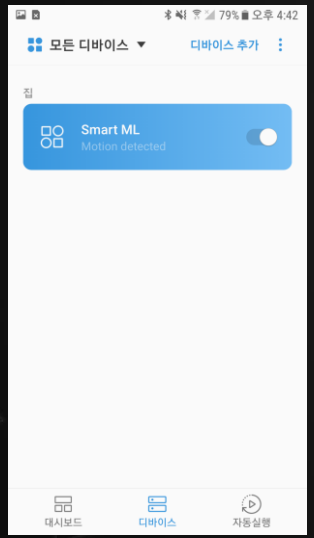
- Project Explorer 내 프로젝트 우클릭 > Run As > Tizen Native App

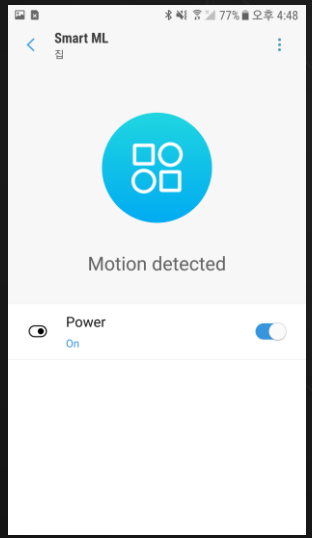


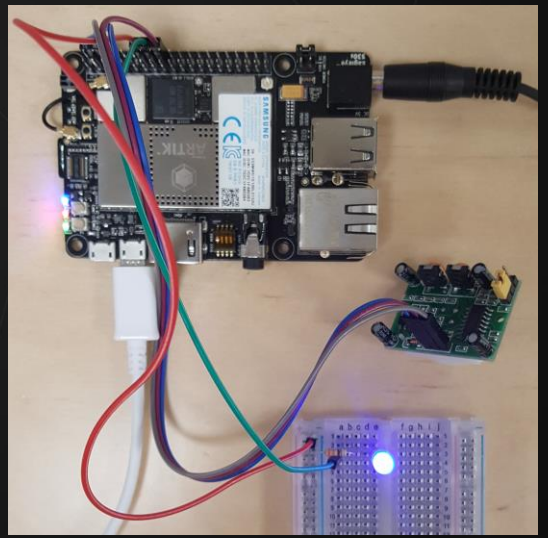
SmartThings: Code Implementation

Easy Setup: SmartThings App – Device 연결

- App UI (Motion 표시창, Power 버튼) 확인







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Thank you