LTE CATM1, Azure IoT Central로 Connected Car 컨셉 제작

CodeZoo

e4ds news

muRata
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vodafone

ASI A-SUNG International CO.,LTD.

CodeZoo

주요내용

CodeZoo
www.codezoo.co.kr

1. LTE Cat.M1 통신
2. 제품 및 부품 소개
3. Vodafone Global IoT Sim 소개
4. Connected Car 동작방식
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6. Azure IoT Central Cloud 설정
7. 펌웨어 연결 코드 입력, 모니터링 및 제어명령 추가
8. 테스트 결과
   - 데이터 실제 사용량 (with Vodafone)
   - 배터리 소모량
9. More Connected Car
   - 아이디어

1. LTE Cat.M1통신

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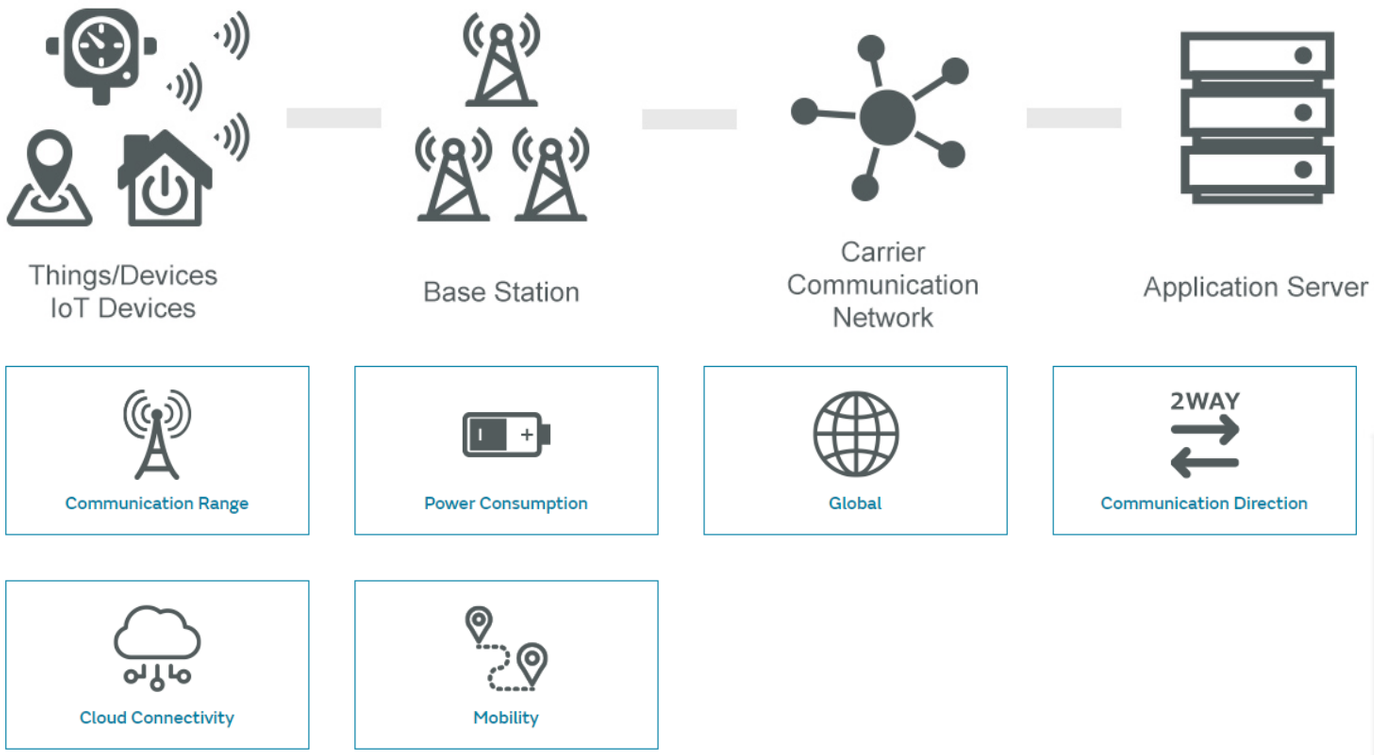
LTE 이동통신망 기반의 저전력 광역 통신 기술 표준 LPWA(Low Power Wide Area)



이미지 출처 : https://www.murata.com

- 통신 인프라가 없어도 사용가능
- 초소형 기기 설치 가능
- 저전력 기기 적합
- 보안이 강화된 무선통신
- 저렴한 통신 비용

국내 주요 IoT 기술 비교

	LTE Cat.M1	LTE-M	LoRa	NB-IoT
주파수	LTE 대역 내 0~1.08MHz 가변	LTE 대역 내 0~20MHz 가변	비면허 대역 125kHz*8채널	LTE 대역 내 180kHz 고정
전송 속도	~300Kbps	~10Mbps	~5.4kbps	~27kbps
가능 서비스	데이터, 음성, 사진	데이터, 음성, 영상	센서 측정치 등 소량 데이터	센서 측정치 등 소량 데이터
배터리 수명	수 년 이상	수 개월	수 년 이상	수 년 이상

※전송 속도는 다운로드 기준 최대 속도

자료=SK텔레콤

2. 제품 및 부품 소개

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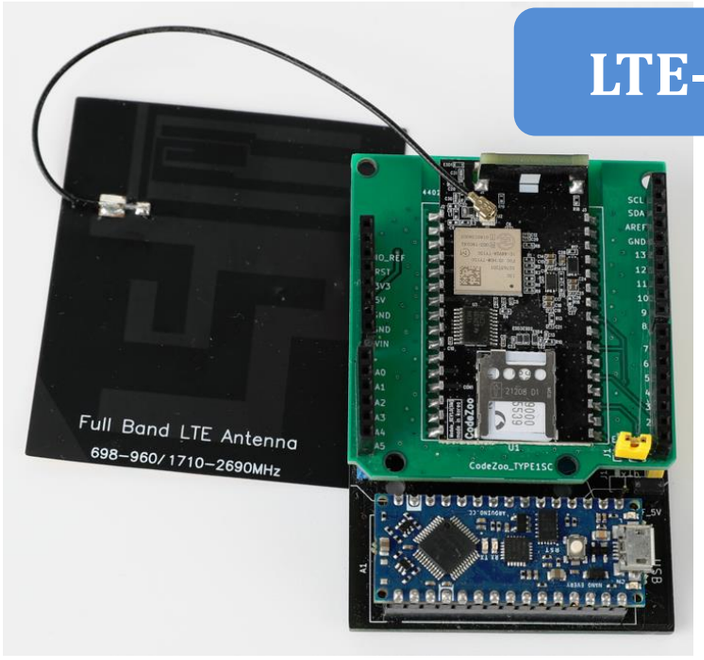
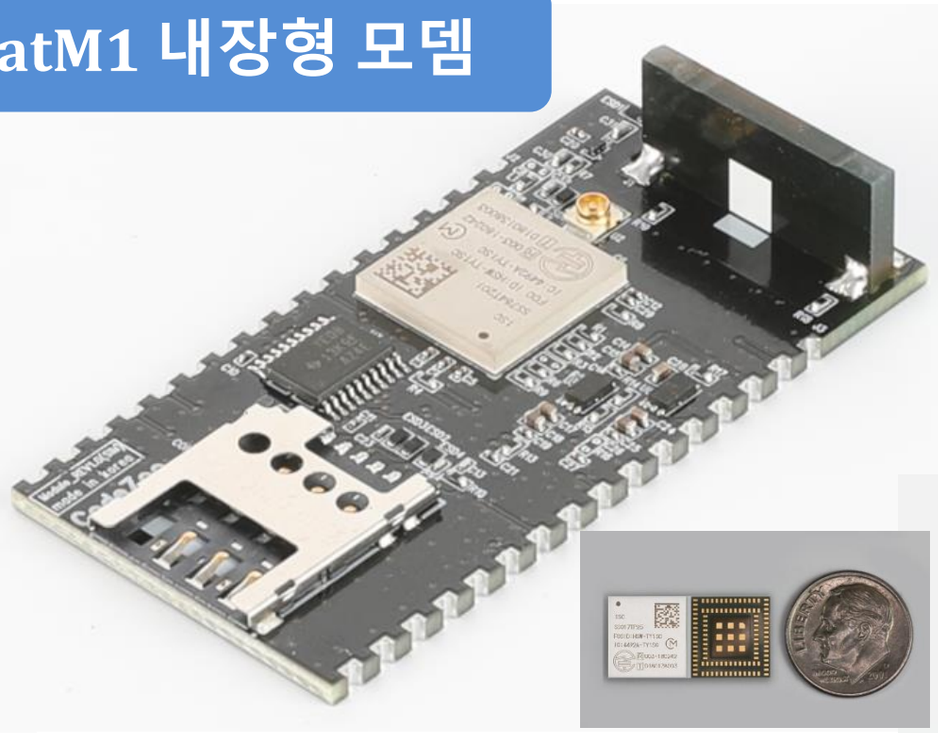
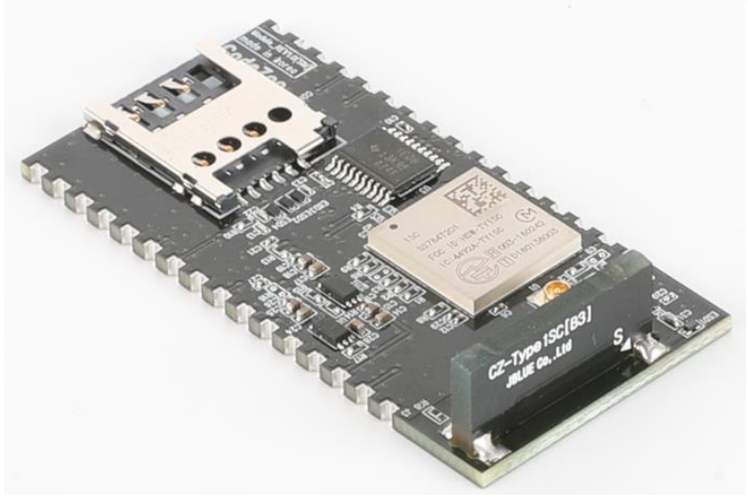
LTE-CatM1 내장형 모뎀



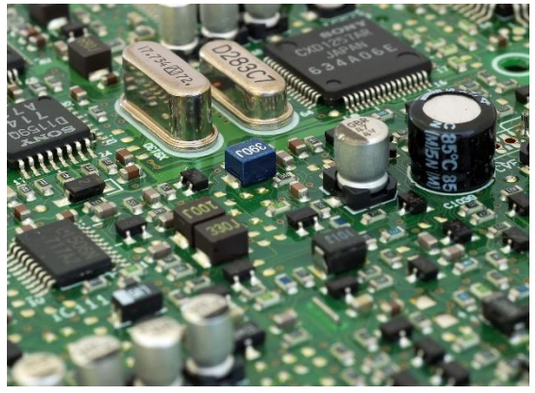


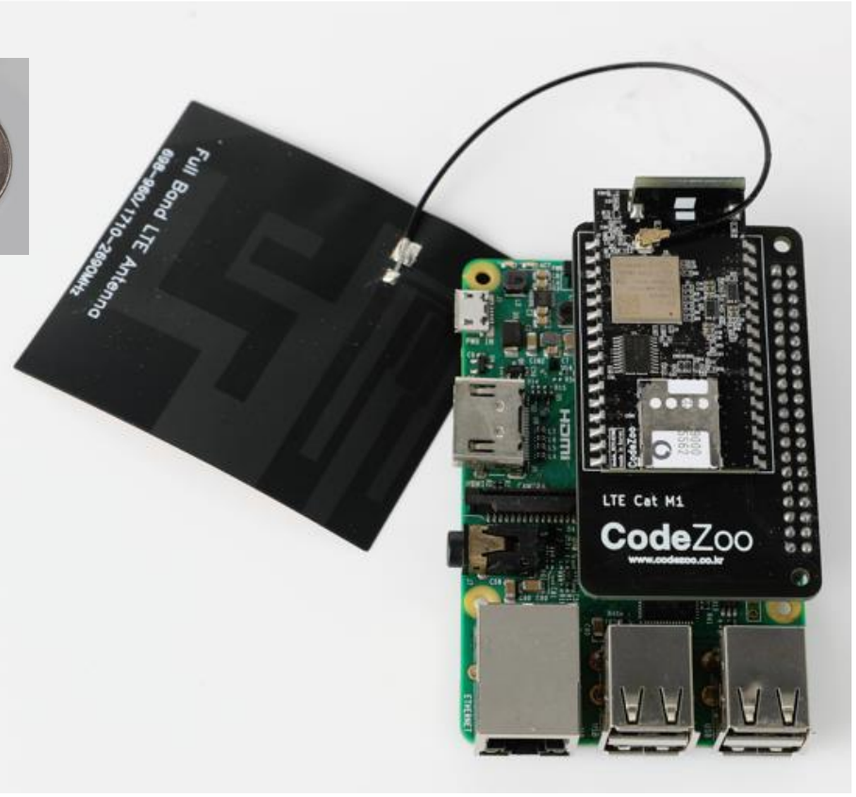
전자/로봇/기계부품 분야 1위 쇼핑몰
DEVICEMART
https://url.kr/u8ipdj

GitHub
https://url.kr/lif94s



200+ Companies design





Murata CatM1 Module(Type 1SC)

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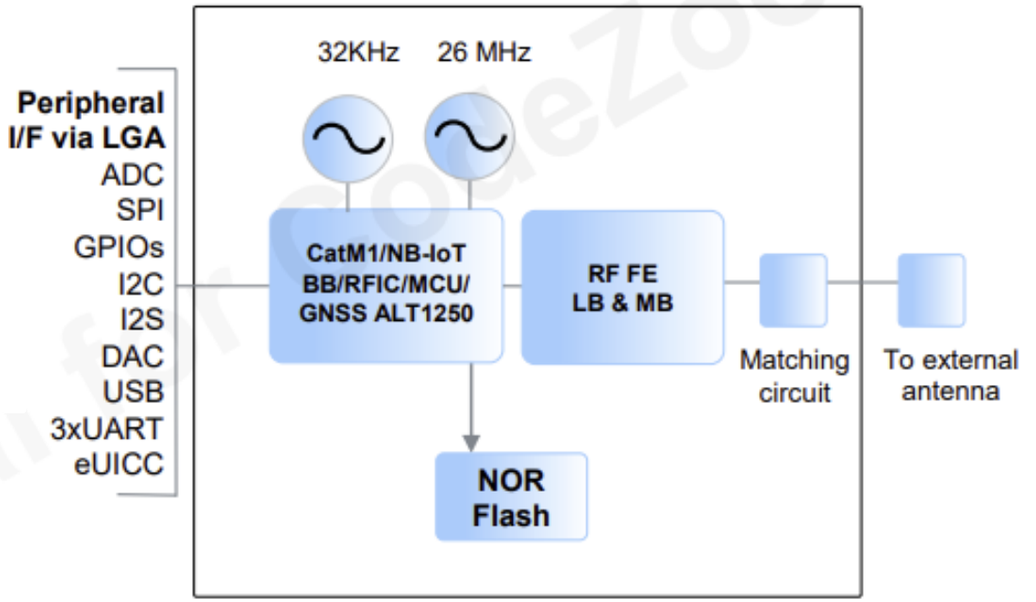
Features

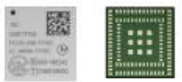
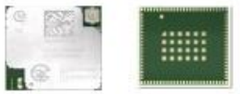
- LTE Cat M1 – 23 dBm
- NB-IoT (NB1) Rel. 13 (Rel. 14 – SW Upgrade)
- Built-in ARM Cortex M4 core with 128KB RAM and 16MB flash (June '18 – SW release)
- GNSS, VoLTE
- Dimension: 11.1 x 11.4 x 1.5 mm
- Package: LGA
- Antenna configurations: external
- SIM card: external
- 3GPP eDRX and PSM modes
- Power Consumption: enables up to 10 year battery life
  - Hibernation current: 3 uA
  - eDRX current: <25 uA @ 8 hyperframes
  - PSM current: dormant window configurable
- Operating temperature range: -40 ℃ to 85 ℃
- OTA firmware upgrade
- RoHS compliant
- Regulatory certificate: FCC/IC/ETSI/TELEC (plan)
- Carrier Certifications: GCF, Verizon, ptcrb, AT&T, Softbank, KDDI, Docomo (Plan)

Applications

- Wearables
- Building automation/Security
- Medical/Healthcare
- Asset Tracking

Module Block Diagram



Type 1SC (MP)	Type 1WG (MP)	Type 1SE (TBD)
PN: LBAD0XX1SC Altair ALT1250 11.4 x 11.1 x 1.5mm Available for AT Command	**PN: LBAD0XX1WG** Altair ALT1250 12.2 x 12.0 x 1.6m Available for AT Command (JP Market only)	**PN: LBAD0ZZ1SE** Altair ALT1250 + STMicro STM32L462 15 x 17 x 1.5mm Available for Open MCU
		
FCC/IC/CE/Japan Certified	Japan Certified	FCC/IC/CE/Japan Certified
FC CE PTCRB GCF		FC CE PTCRB GCF

altair
A Sony Group Company

㈜ 아성코리아

"글로벌 전자 부품 및 자동화 제품을 제공하는 기술 대리점입니다."

ASI A-SUNG International CO.,LTD.

1992년 설립

2,200억원 매출

4개국, 16개 거점
(한국,중국,베트남,인도)

200명 임직원

1,500 고객사수

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ROHM SEMICONDUCTOR

OMRON

RICHTEK your power partner.

socionext

starpower

kinetic technologies

UNIVERSAL ROBOTS Preferred Distributor

on robot

ZIMMER group

MECH MIND

20개 이상의
글로벌 벤더

기술 지원

CodeZoo www.codezoo.co.kr

자체 AE, FAE 운영 및 ㈜코드주를 통한
글로벌 Tier1 벤더 제품 기술 지원

효율성 향상

다양한 전자 부품, 자동화 제품 소싱

Hardware, Software 지원 및 외주개발 서비스
(벤더 별 사전 협의 필수)

안정성 신뢰

31년 업력으로 안정적인 재무구조

신뢰할 수 있는 B2B 엔지니어 및 영업 전문가 보유

연락처 070.4235.1156

이메일 주소 asungmaster@asung.com

서울시 강남구 테헤란로 114길24 아성빌딩

SIMPLE2750

3. Vodafone Global IoT Sim 소개

N 쇼핑

https://url.kr/m2yie6

CodeZoo
www.codezoo.co.kr

Vodafone Global Sim

IoT 디바이스 연동 기술지원 서비스

CodeZoo
www.codezoo.co.kr

Vodafone Global Sim

SimCard, Data Plan 판매

Global IOT SIM?

1. 해외 시장 개척 시 유리

하나의 SIM으로 180개국 이상에서 로밍(roaming)하여 사용할 수 있으므로 해외에서 진행하는 프로젝트에 쉽게 적용 (각국 통신사 협의 불필요)

2. Time to market

복잡한 인증 절차를 Global SIM 기반 글로벌 표준 인증(3GPP)만으로 여러나라 통신사의 서비스 지원

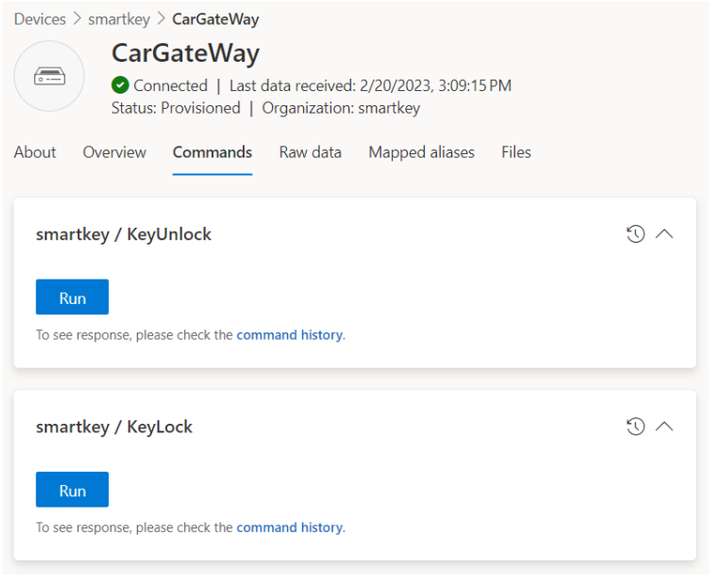
3. KT LTE-M 서비스 지원

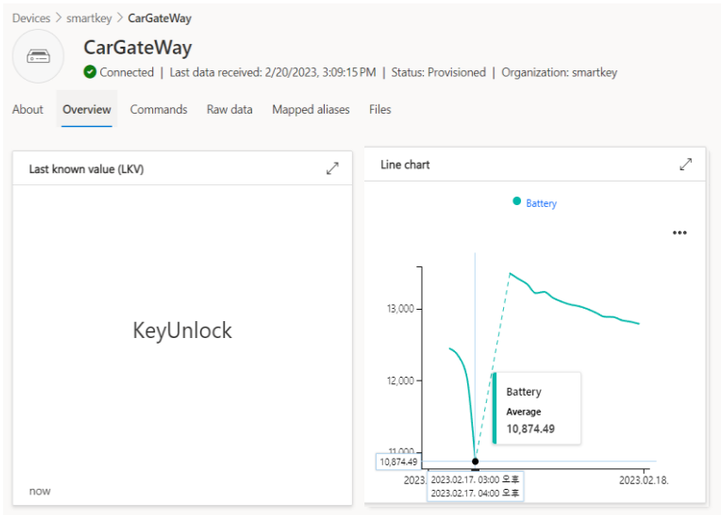
KT망 연결시 PSM 모드를 포함한 LTE-M 서비스 지원

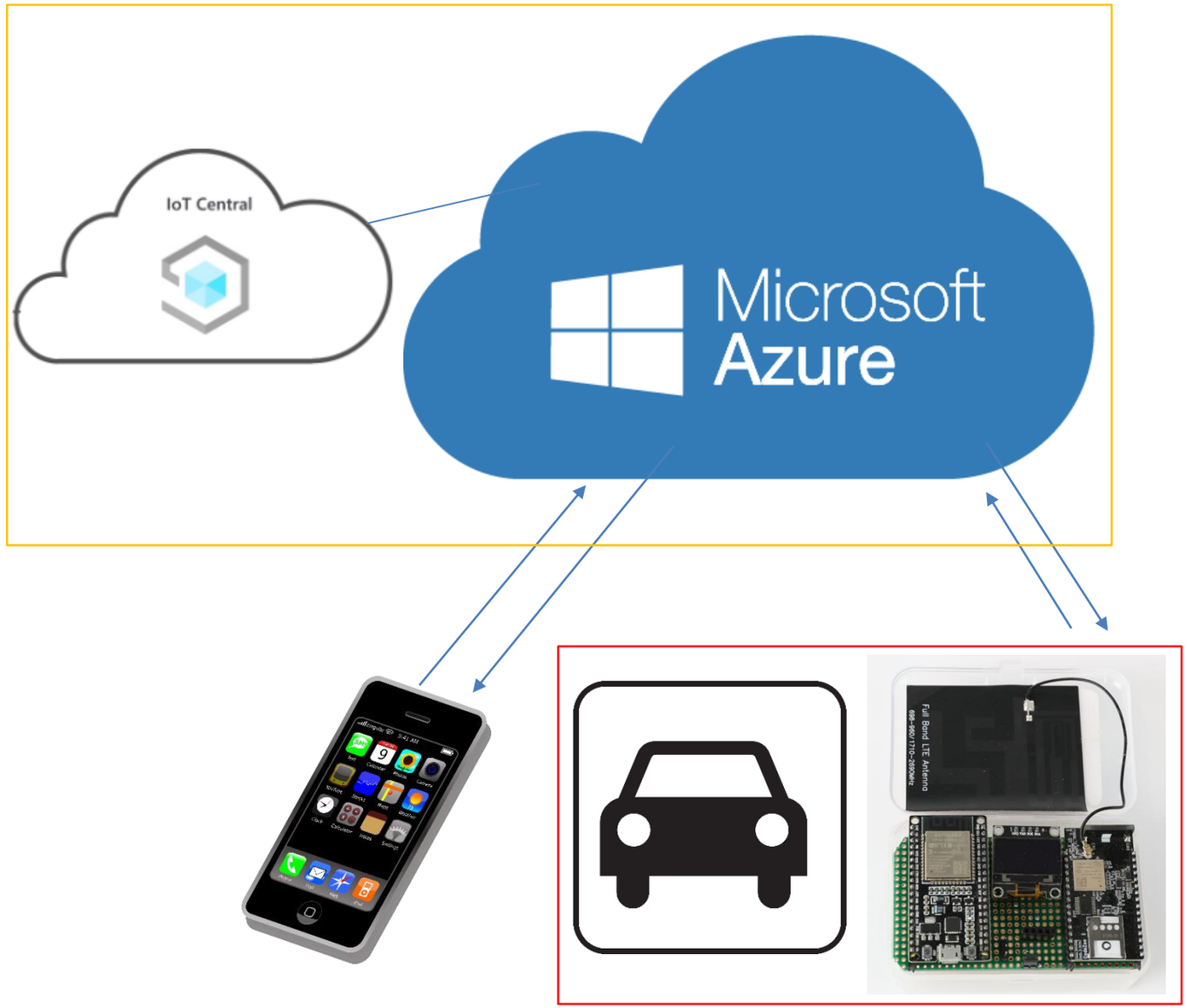
4. IoT 전문업체에서 기술 지원

IoT H/W, S/W 10년이상의 경험을 지닌 CodeZoo에서 기술 지원

4. Connected Car 동작방식

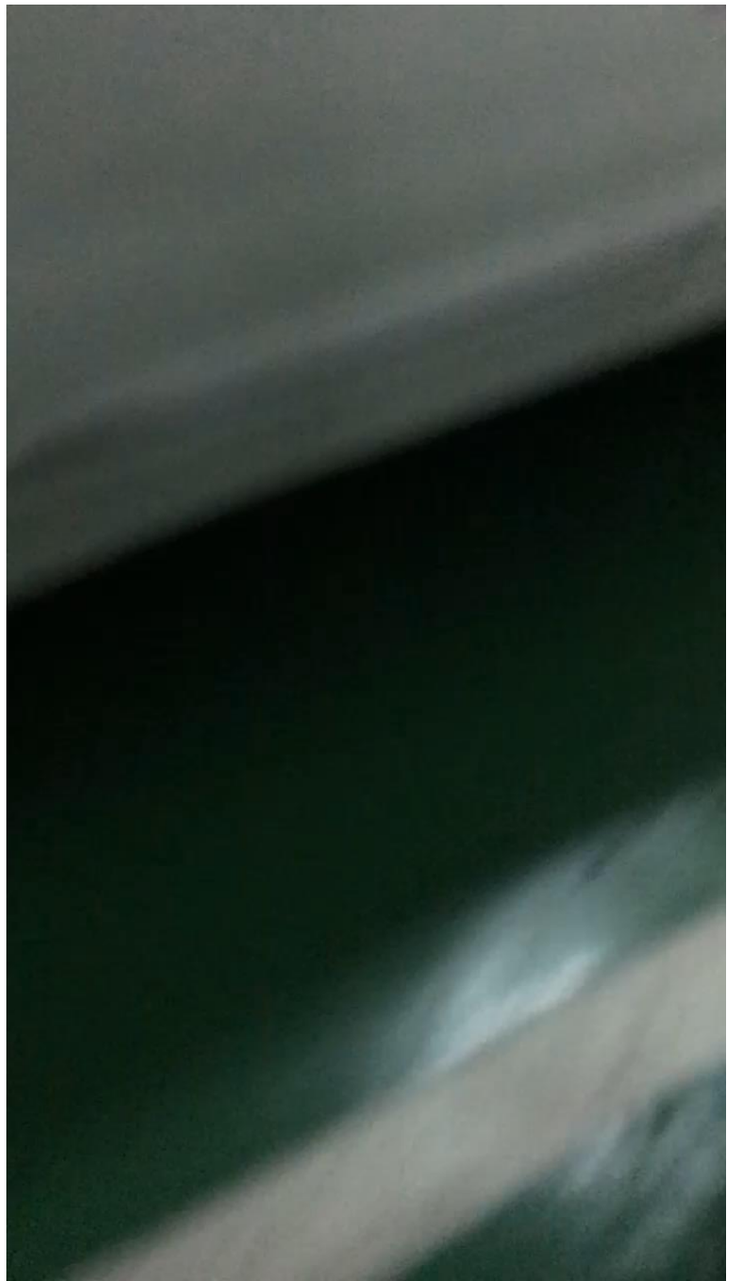


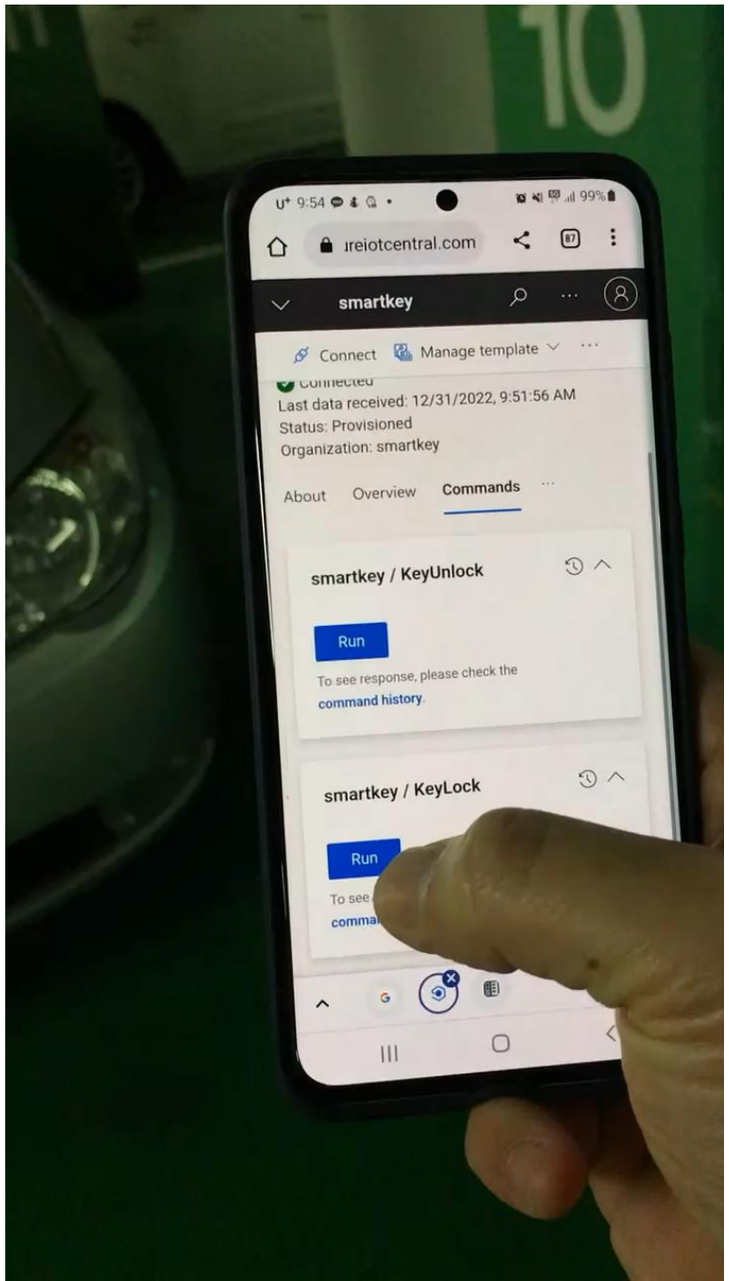




4. Connected Car 동작방식

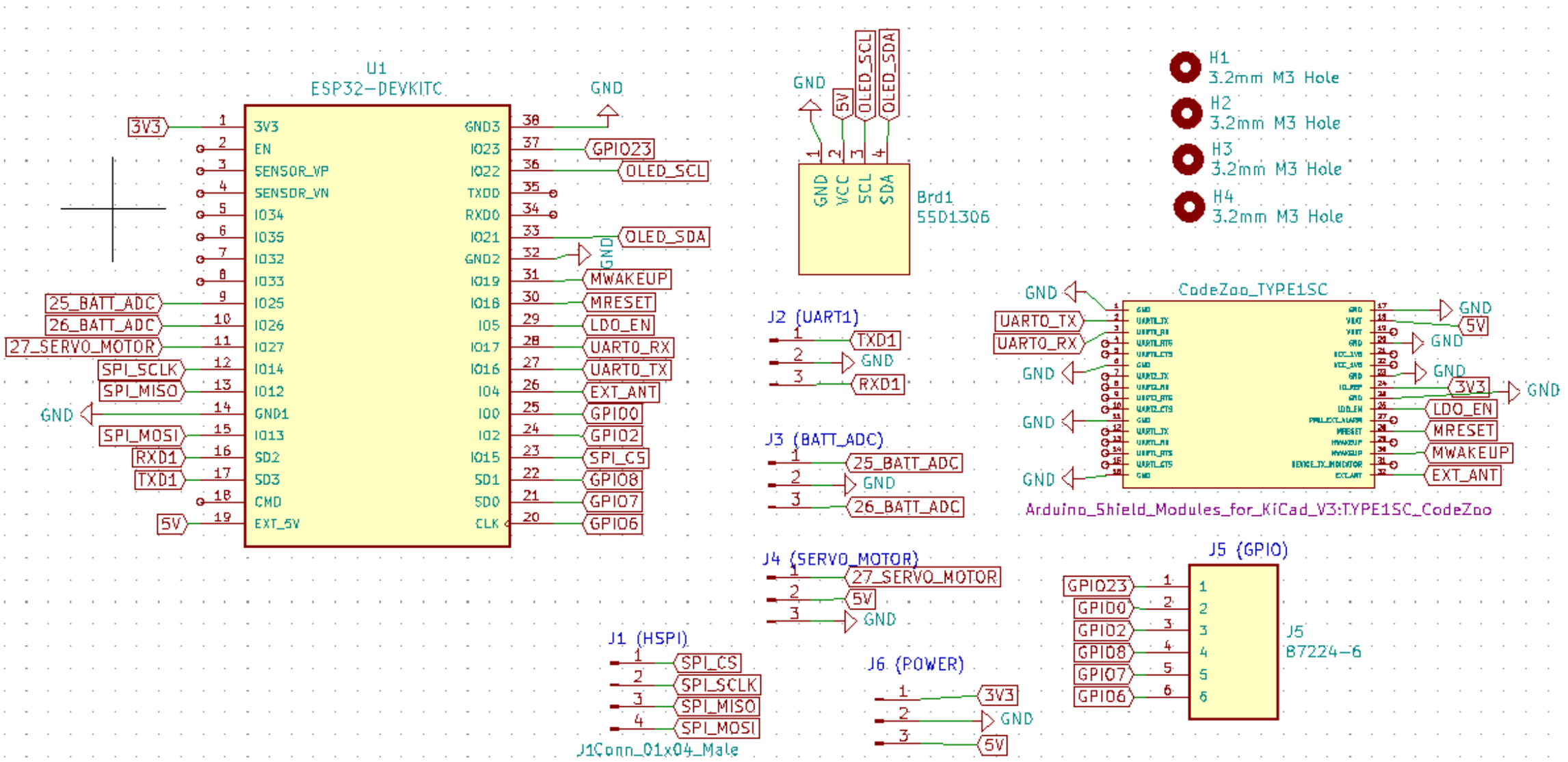
CodeZoo
www.codezoo.co.kr





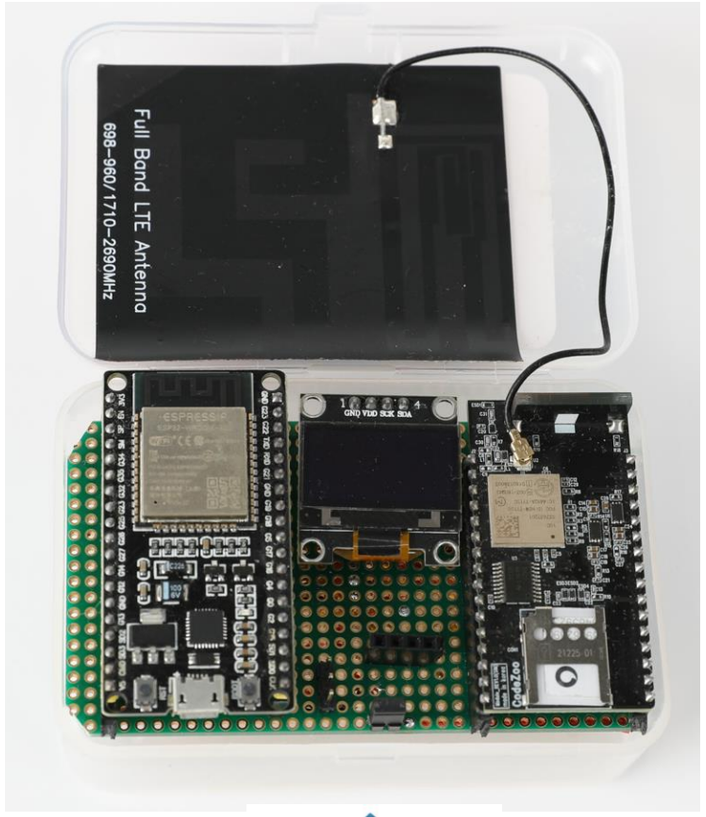
5. H/W, S/W 셋업

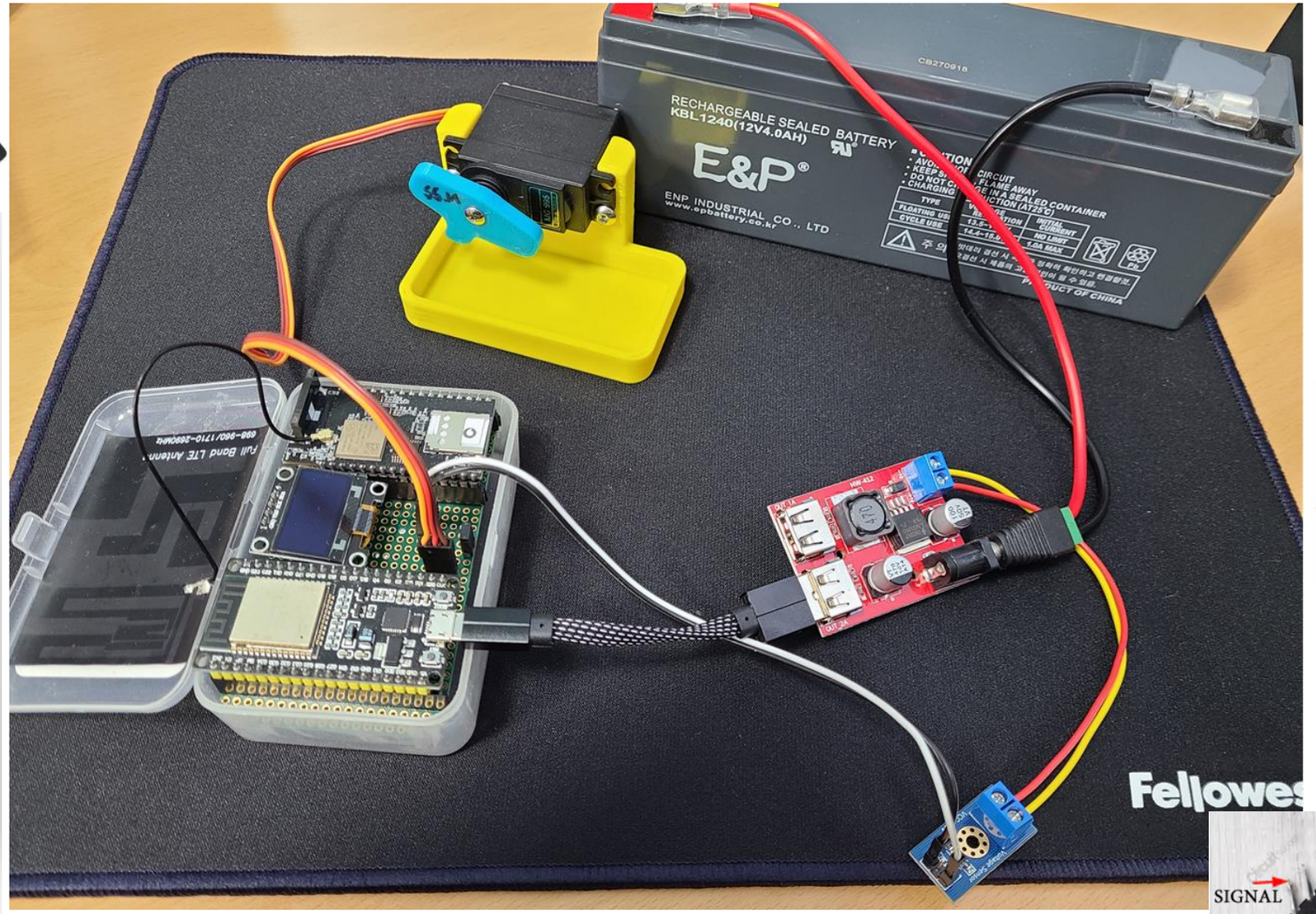
CodeZoo
www.codezoo.co.kr

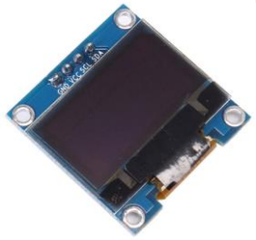


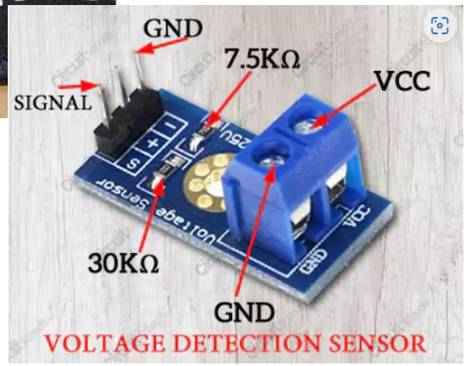
5. H/W, S/W 셋업


Tower Pro
MG995


Full Band LTE Antenna
698~960/1710~2690MHz


RECHARGEABLE SEALED BATTERY
KBL-1240(12V4.0AH)
E&P®
ENP INDUSTRIAL CO., LTD
www.epbattery.co.kr




GND
7.5KΩ
SIGNAL
VCC
30KΩ
GND
VOLTAGE DETECTION SENSOR

5. H/W, S/W 셋업

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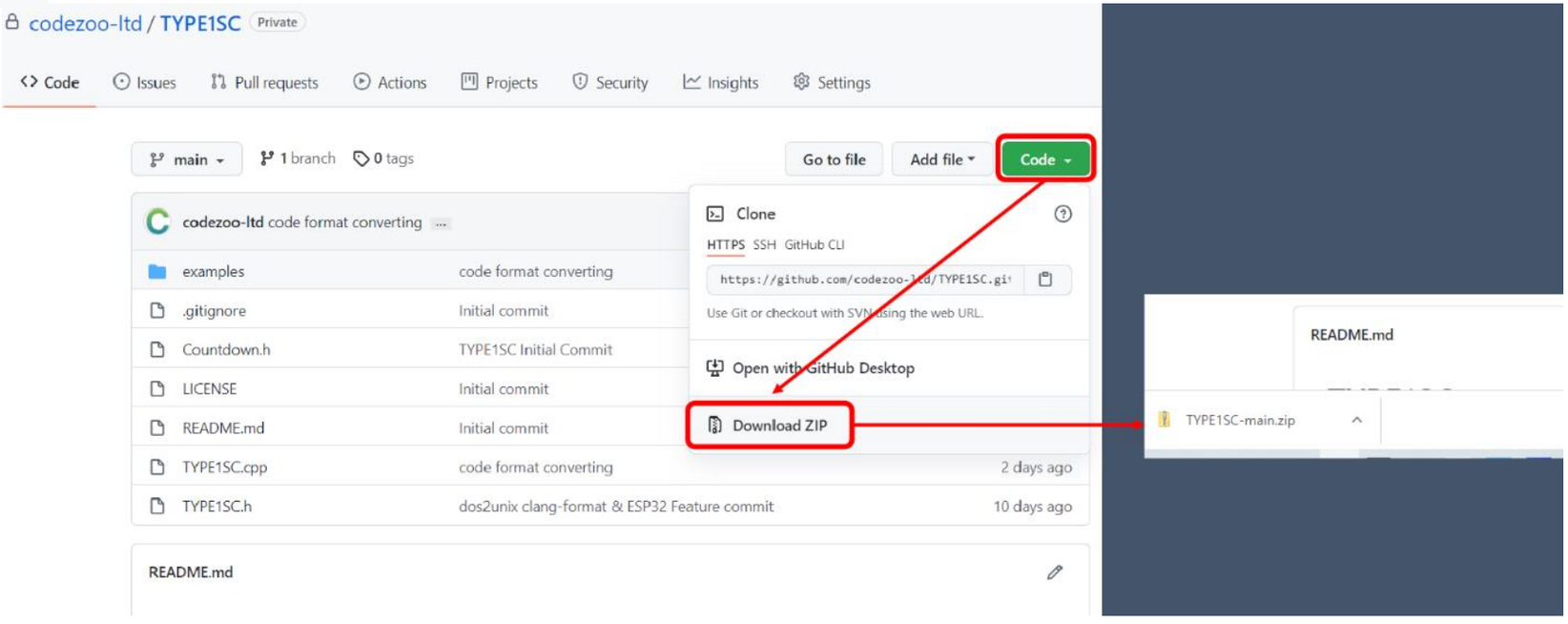
✓ 기본설정
LTE-CATM1_내장형모뎀_ESP32_핸즈온.pdf https://url.kr/7vrgiz

✓ CodeZoo CATM1 Library Install

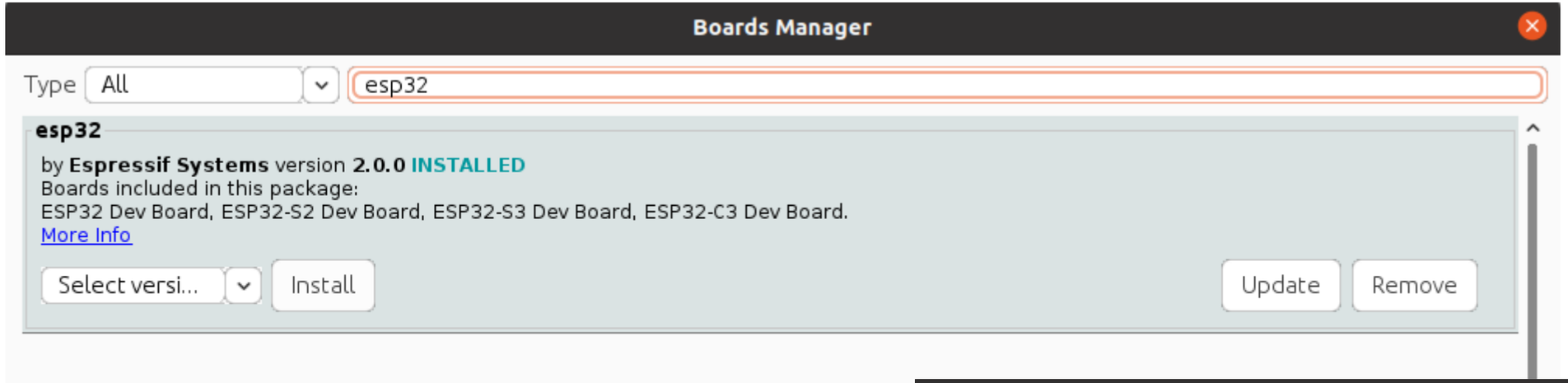
codezoo-ltd / TYPE1SC Public https://url.kr/79edo3 (기본설정)

codezoo-ltd / ppposclientSecure Public https://url.kr/et5nv1 (핸즈온과 동일한 방법으로 설치)

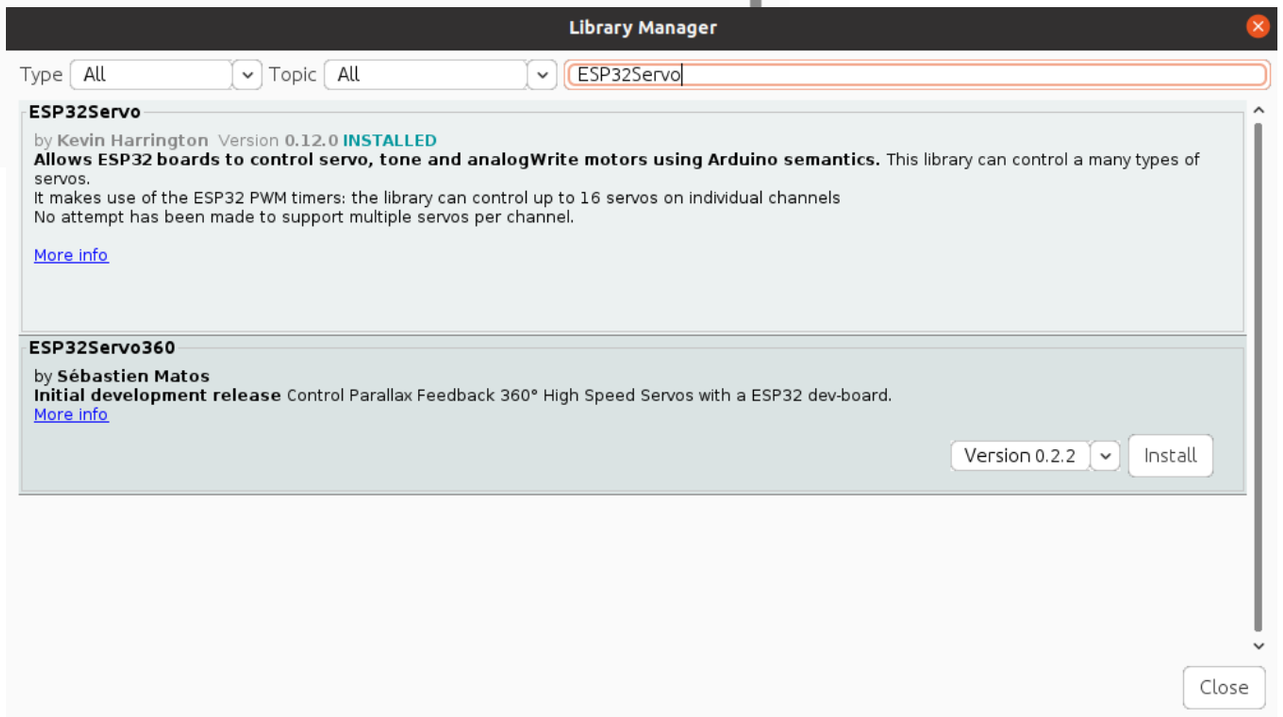


5. H/W, S/W 셋업

✓ Arduino ESP32 2.0.0 SDK Install (pppos enabled)



✓ Arduino ESP32Servo Library Install



5. H/W, S/W 셋업

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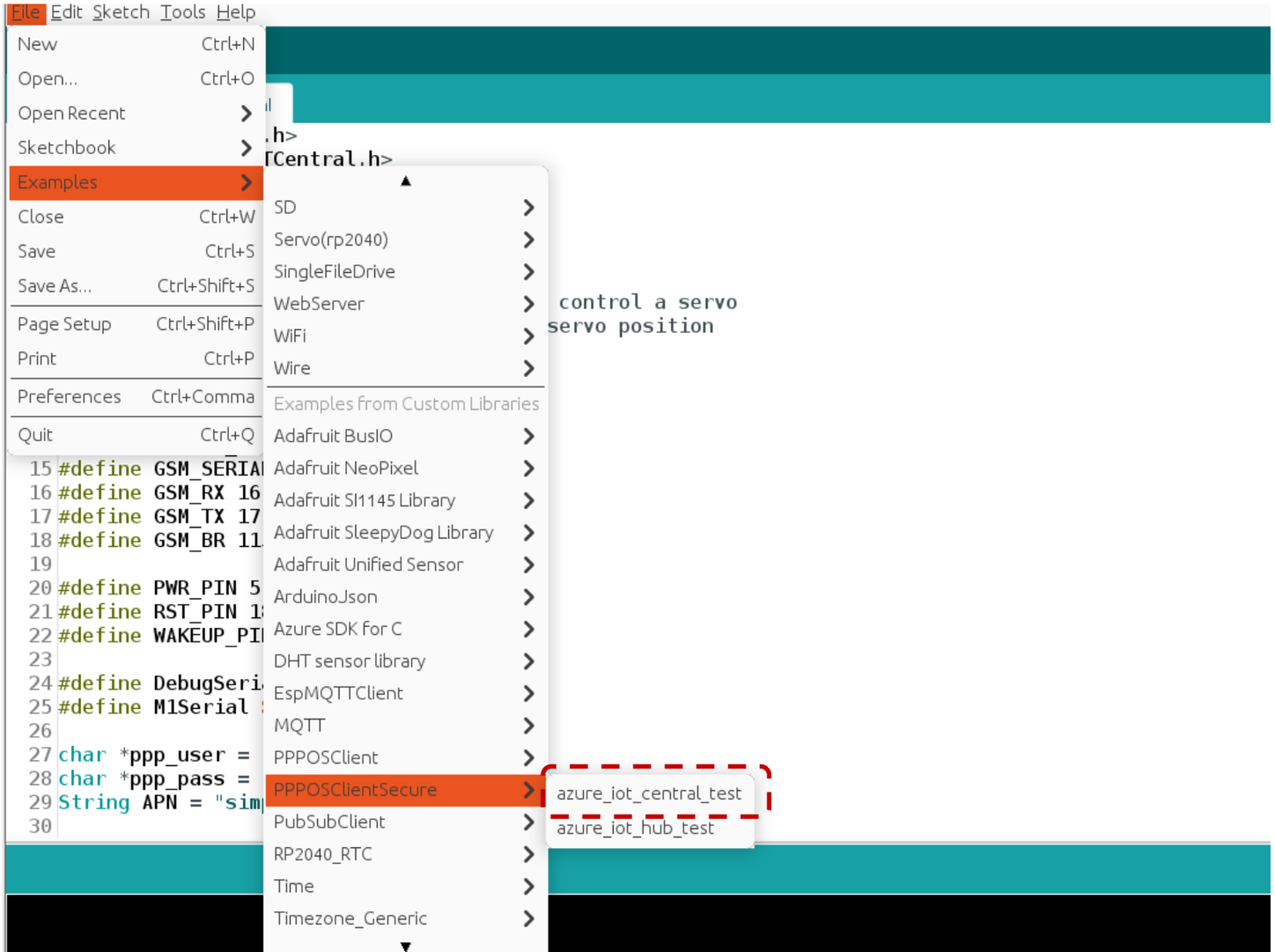
✓ Examples --> PPPOSClientSecure --> azure_iot_central_test 선택



6. Azure IoT Central Cloud 설정

✓ 가격정책

Pricing Tier	Standard Tier 0	Standard Tier 1	Standard Tier 2
Use Case	For devices sending a few messages per day	For devices sending a few messages per hour	For devices sending a message every few minutes
Price per device per month	**$0.08** per Month	**$0.40** per Month	**$0.70** per Month
Monthly device message allocation*	400 messages	5,000 messages	30,000 messages
Included free quantities per application	2 free devices (800 included messages)	2 free devices (10,000 included messages)	2 free devices (60,000 included messages)
Overage pricing per 1K messages[1]	**$0.07** per 1K messages	**$0.015** per 1K messages	**$0.015** per 1K messages

* Total message allocation is shared across all devices in an IoT Central Application

[1] The standard message size is 4KB. For example, if the device sends a 4.5KB message it will be billed as 2 messages.

6. Azure IoT Central Cloud 설정

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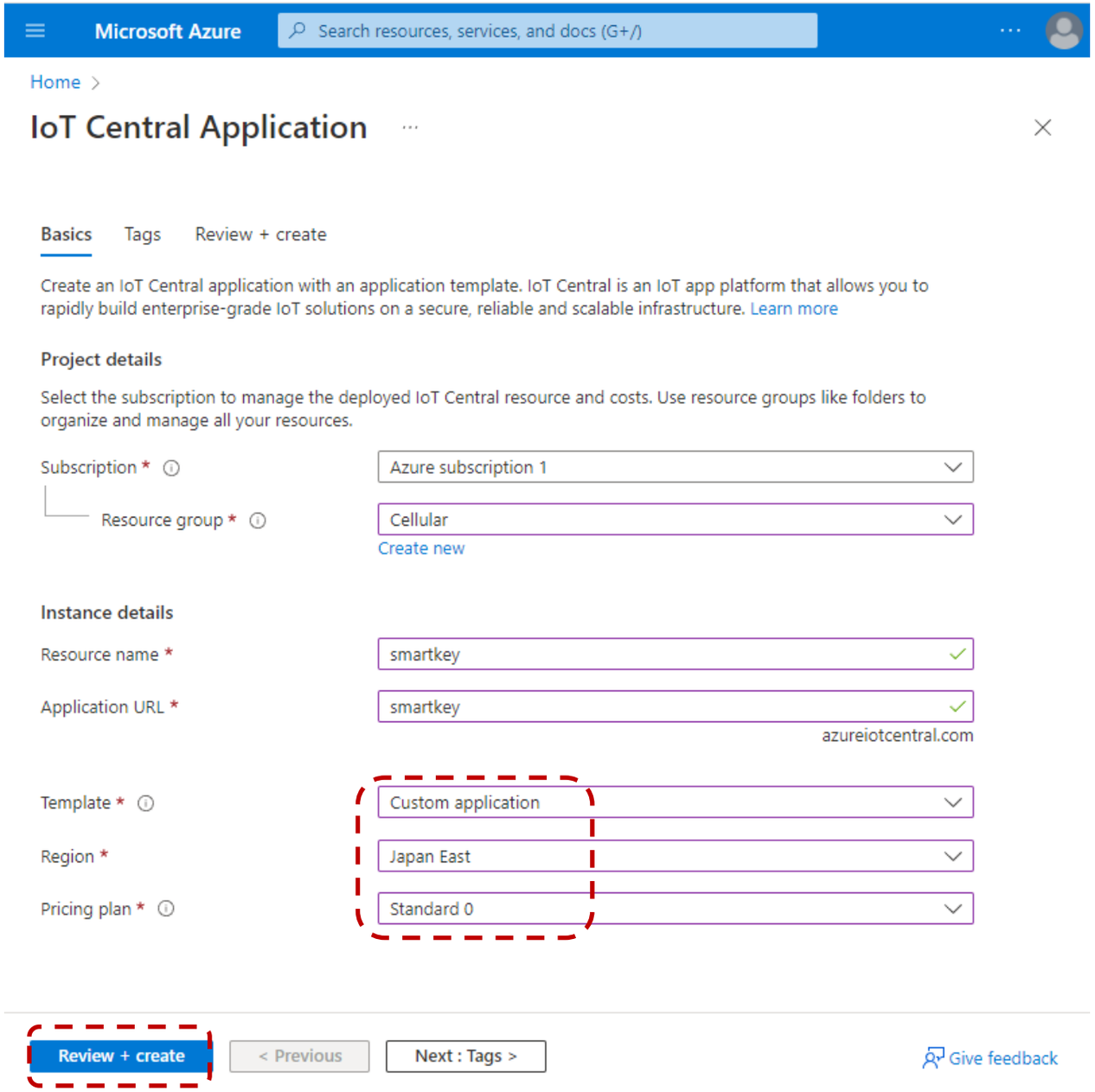
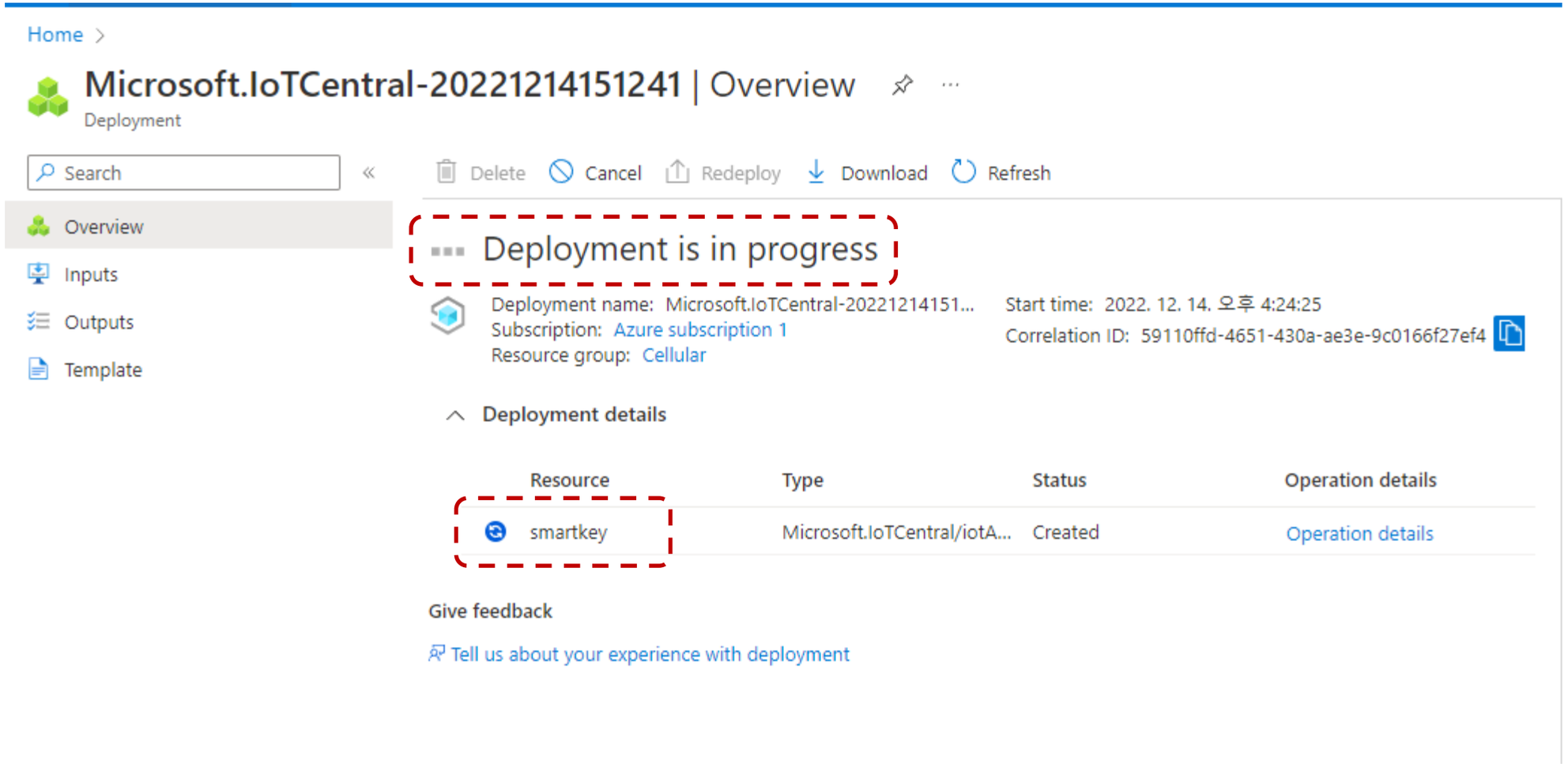
1) 프로젝트 설정

Resource name : 고유값
Application URL: 고유값



6. Azure IoT Central Cloud 설정

2) 프로젝트 생성



6. Azure IoT Central Cloud 설정

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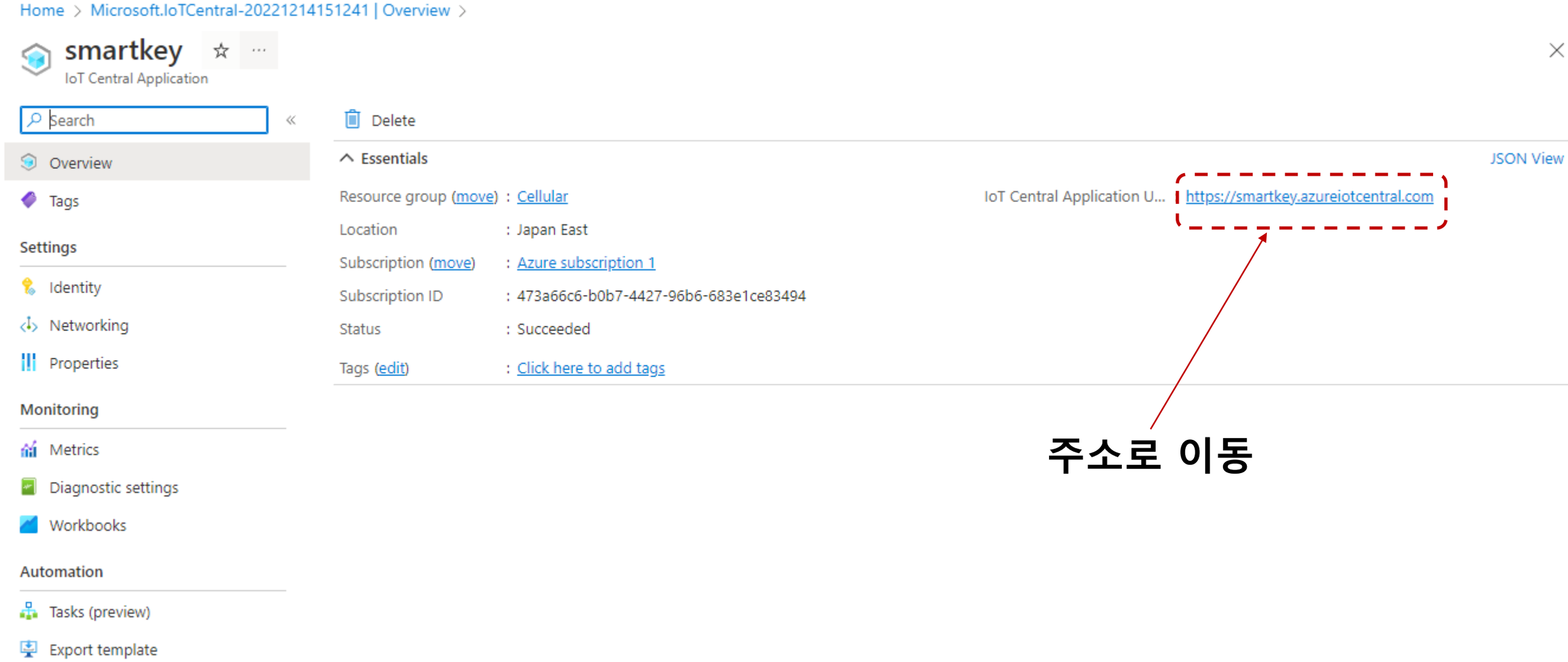
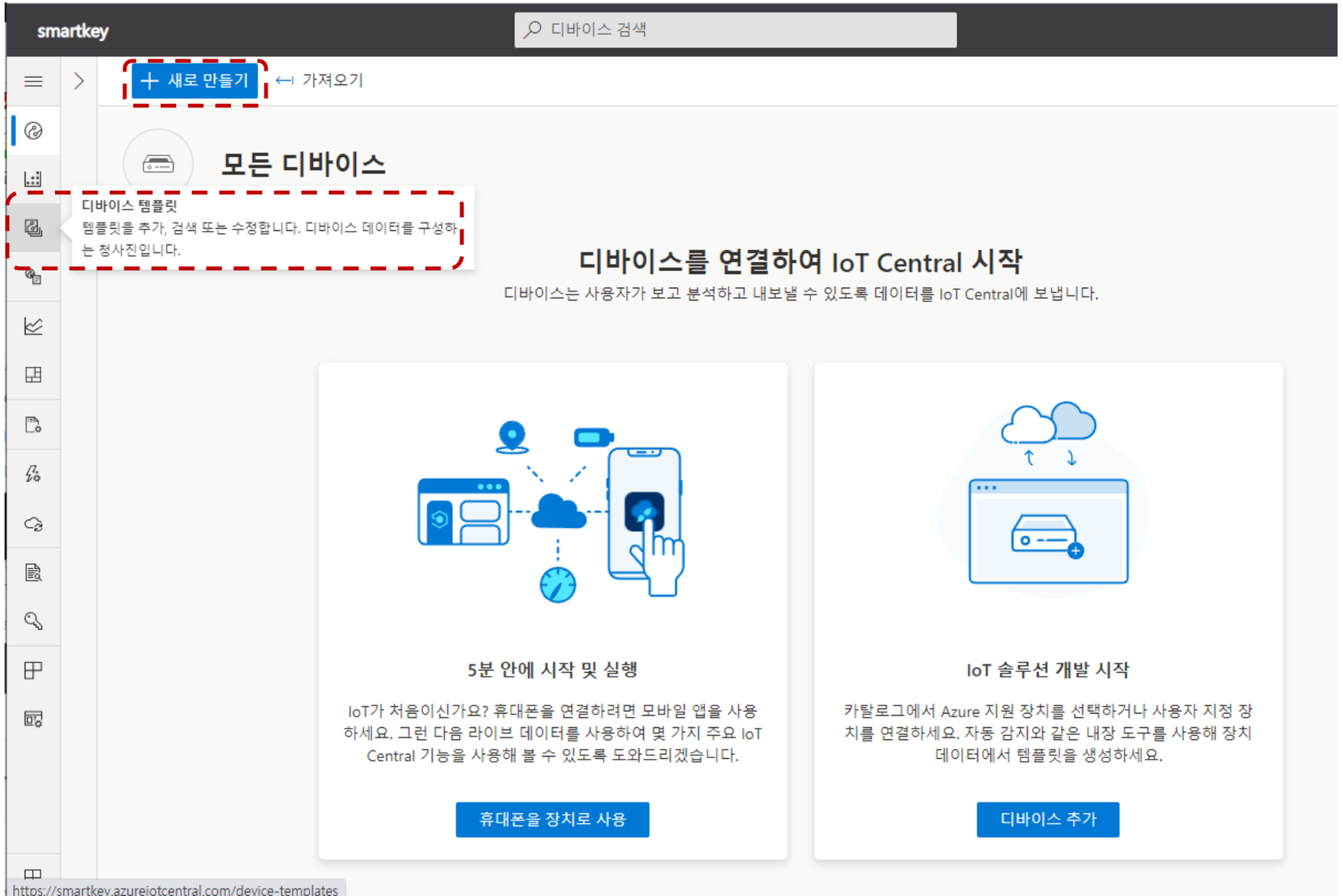
3) IoT Central Application URL 생성

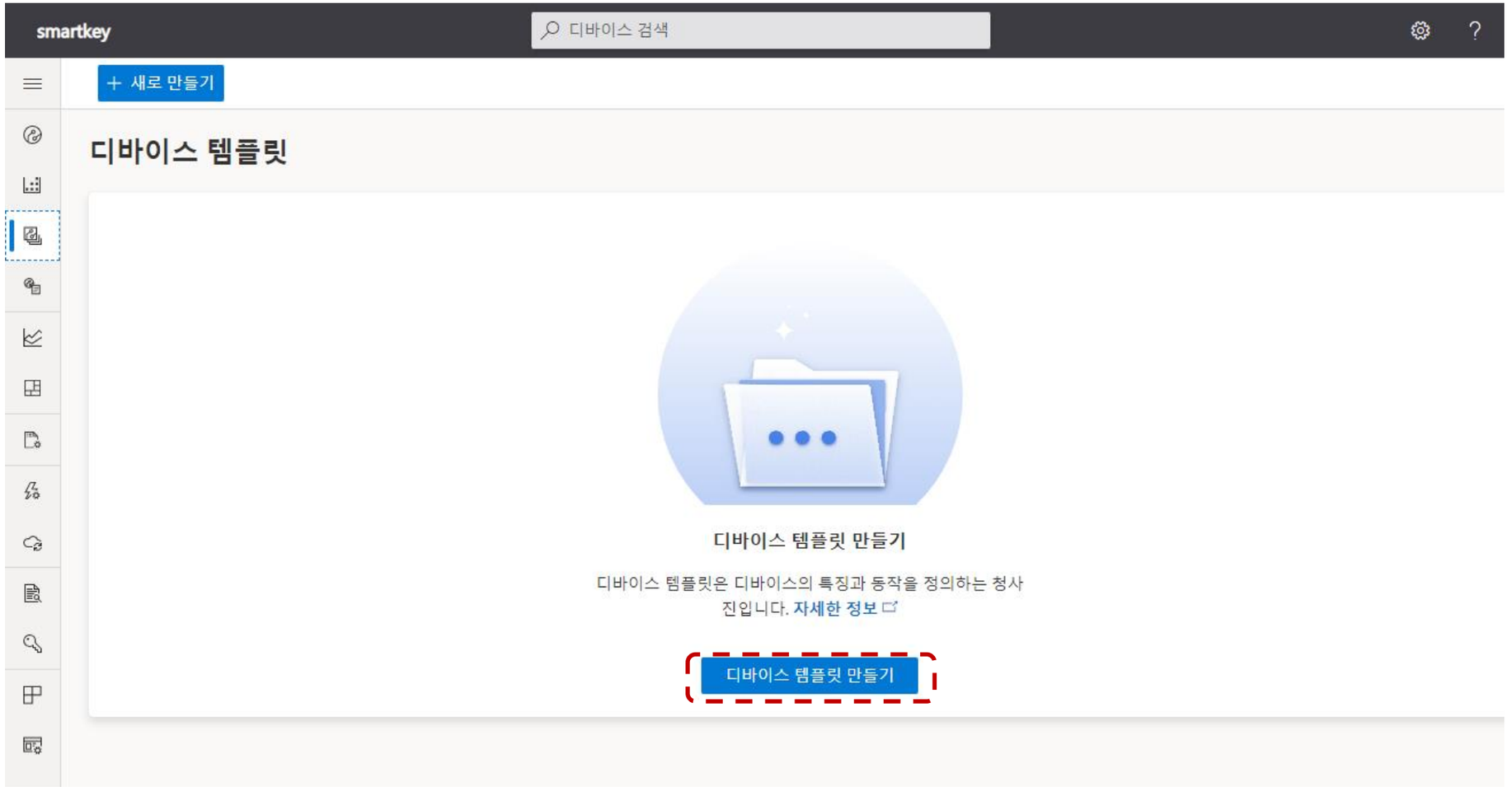


6. Azure IoT Central Cloud 설정

4) Device Template 제작

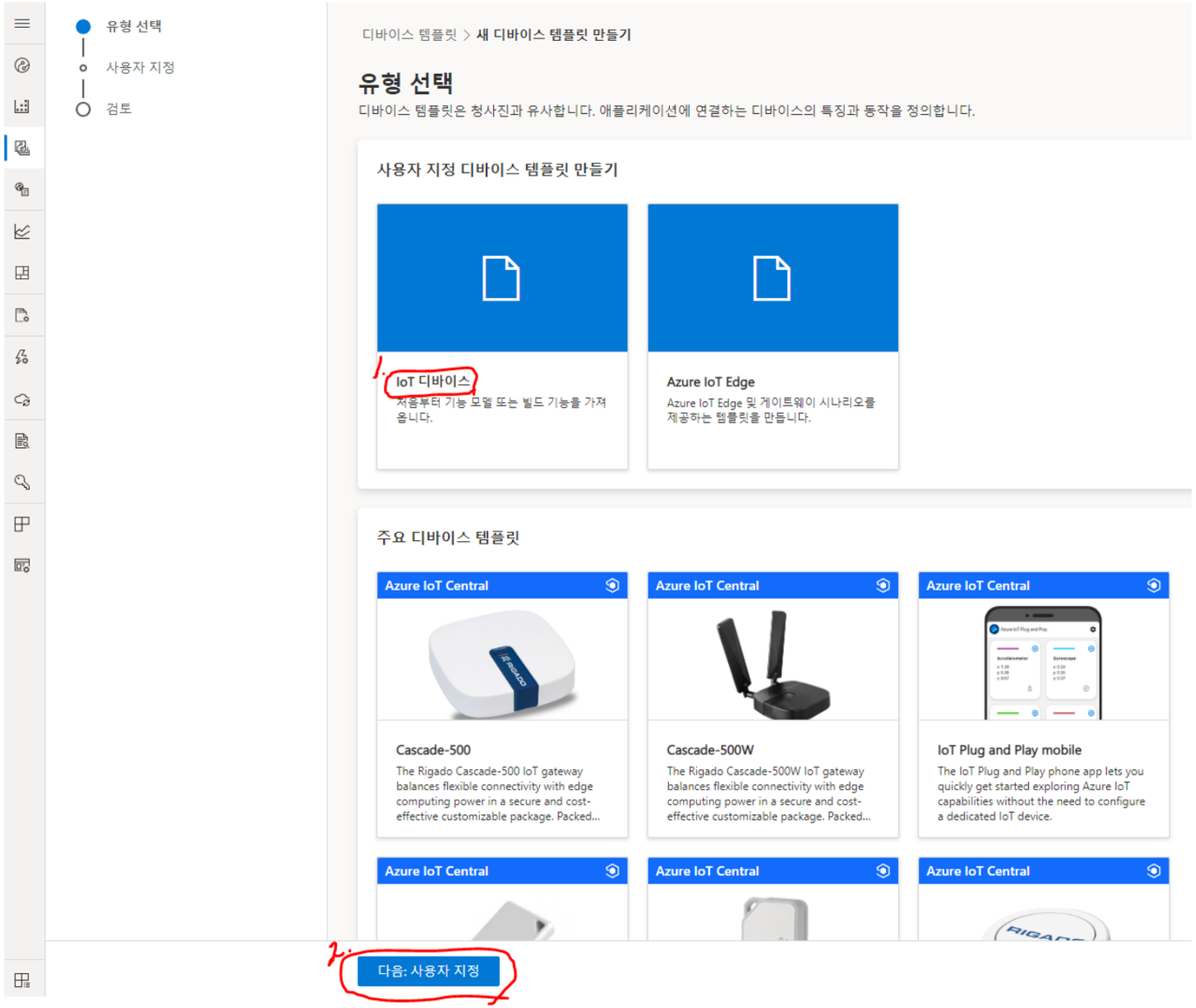


4) Device Template 제작

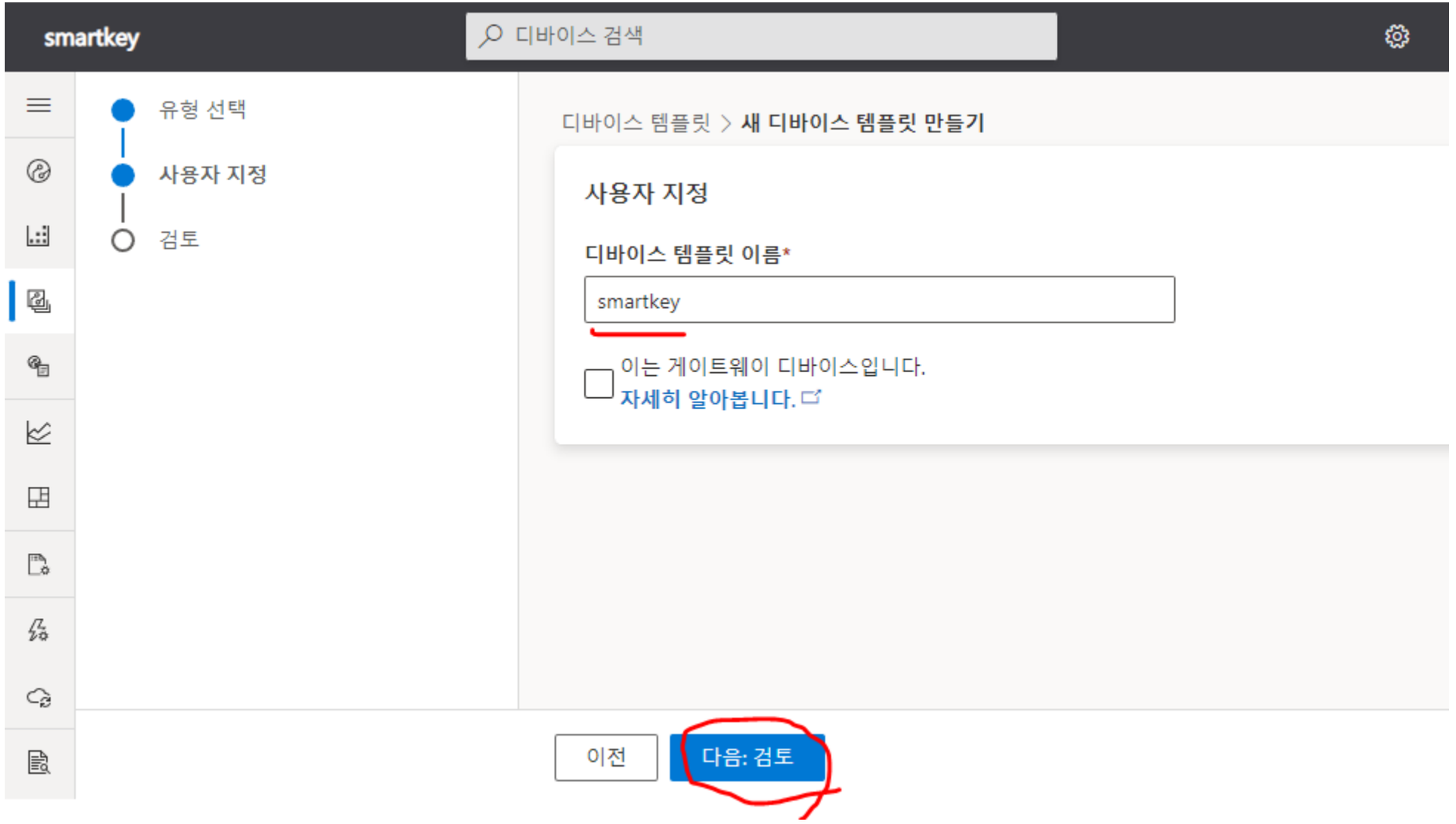


6. Azure IoT Central Cloud 설정

4) Device Template 제작

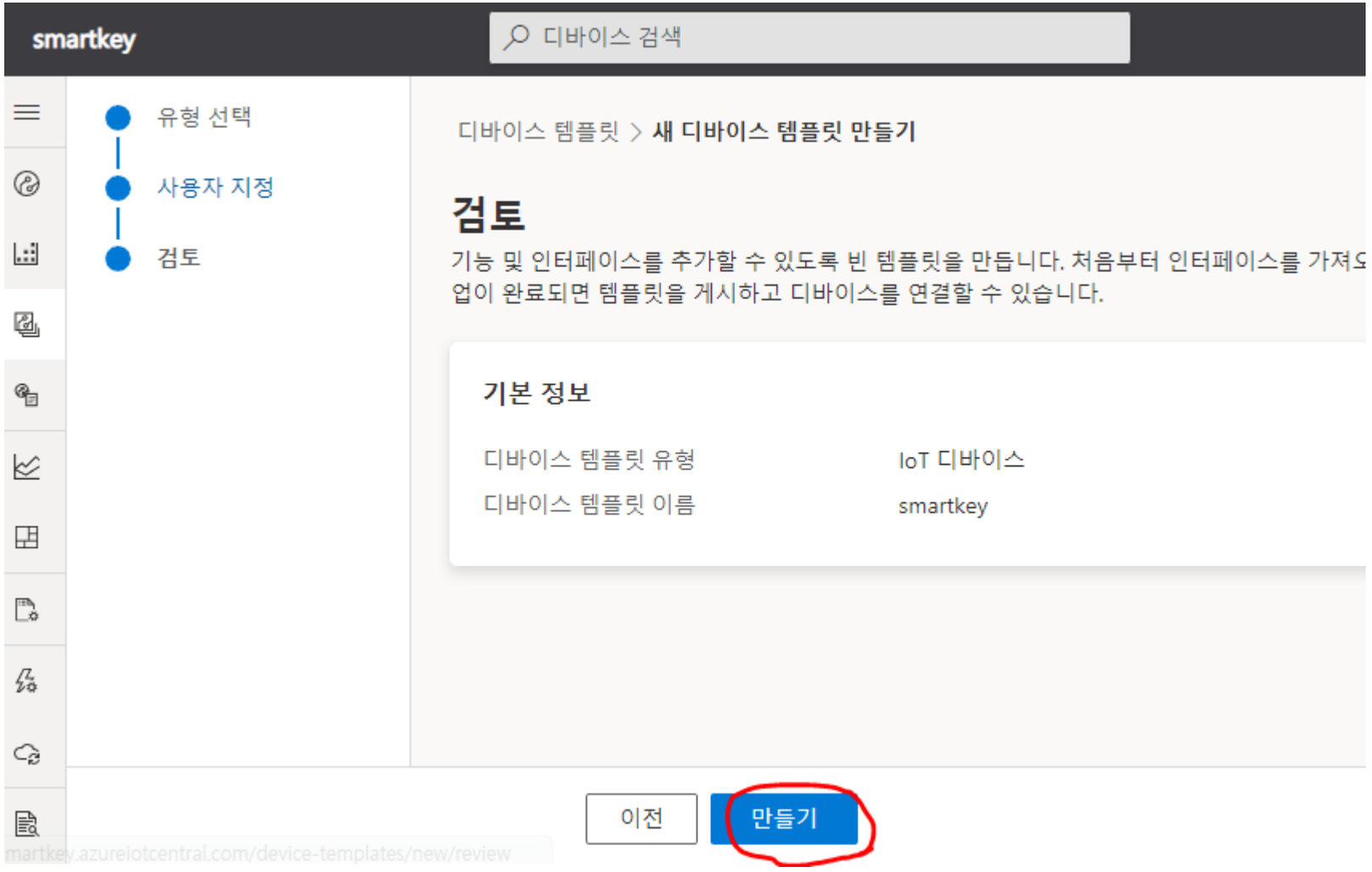


4) Device Template 제작



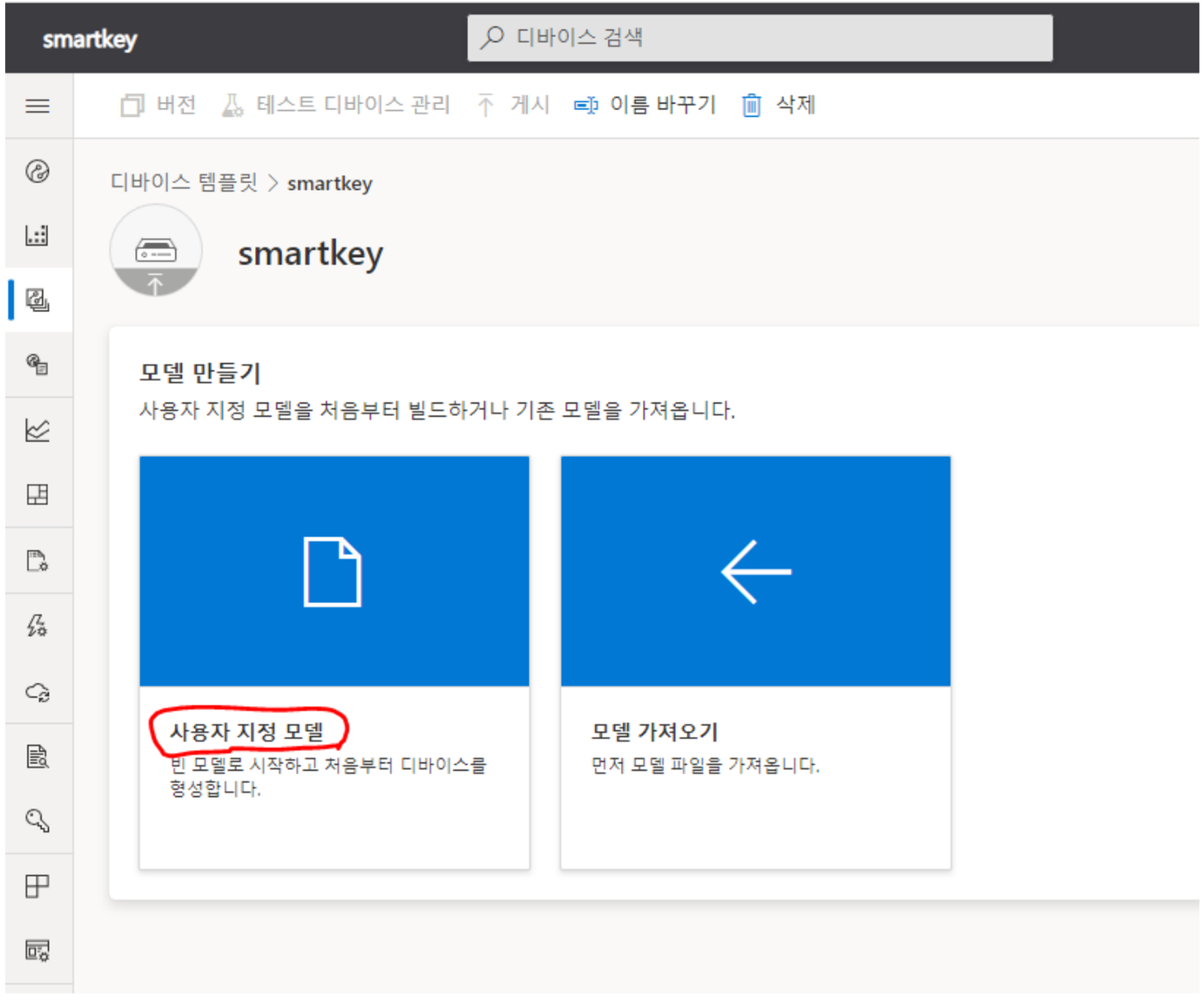
6. Azure IoT Central Cloud 설정

4) Device Template 제작

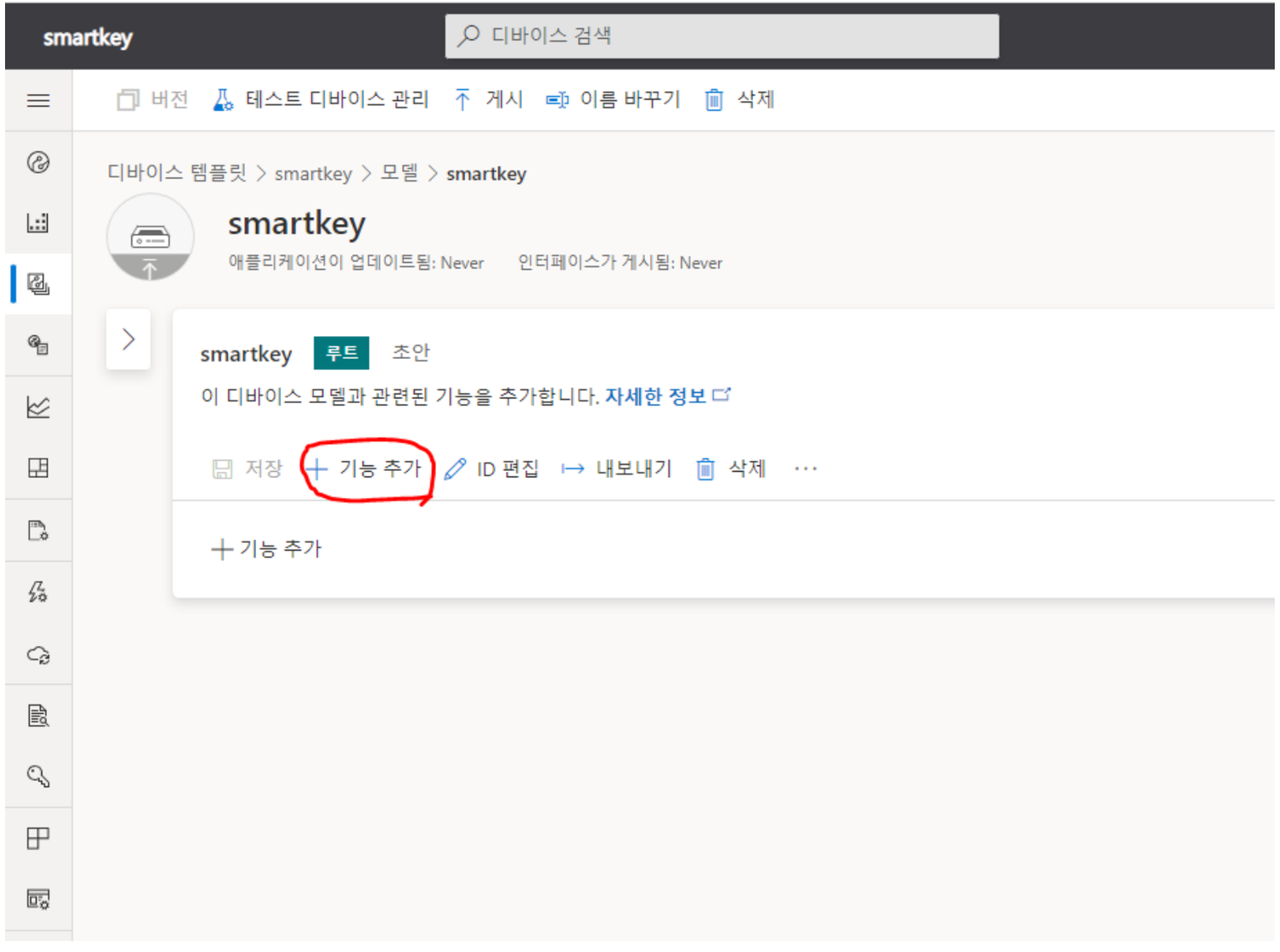


6. Azure IoT Central Cloud 설정

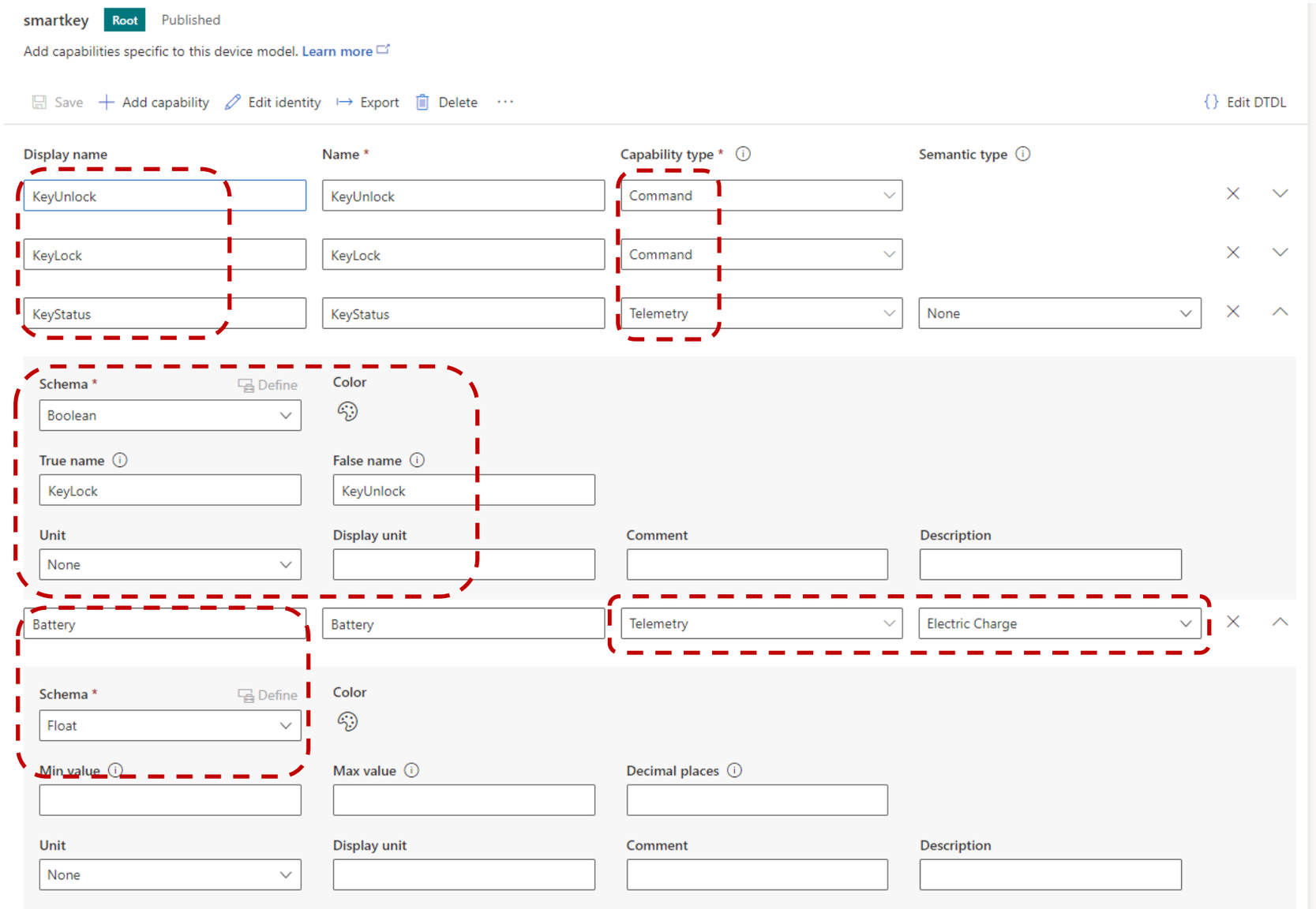
4) Device Template 제작



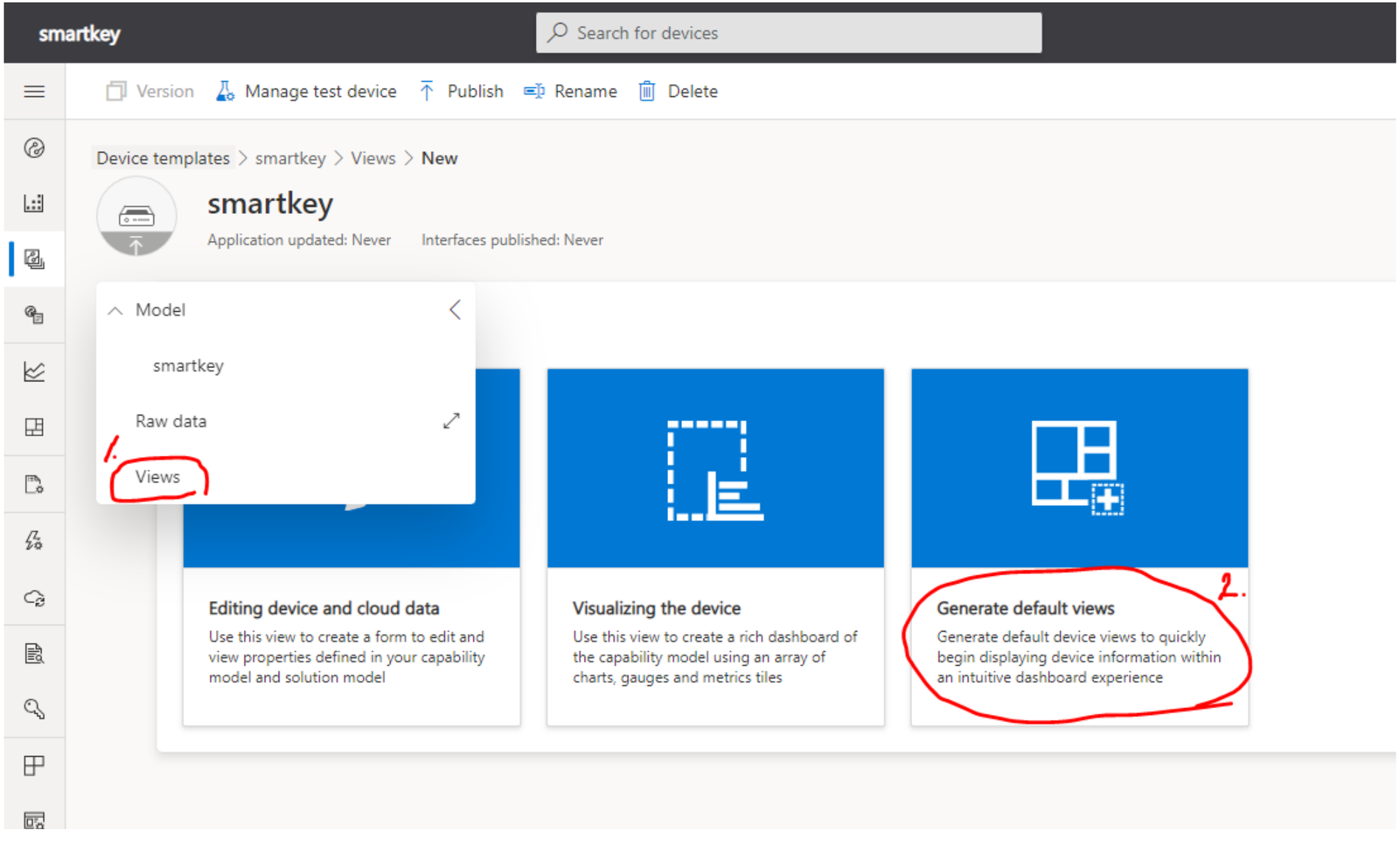
4) Device Template 제작



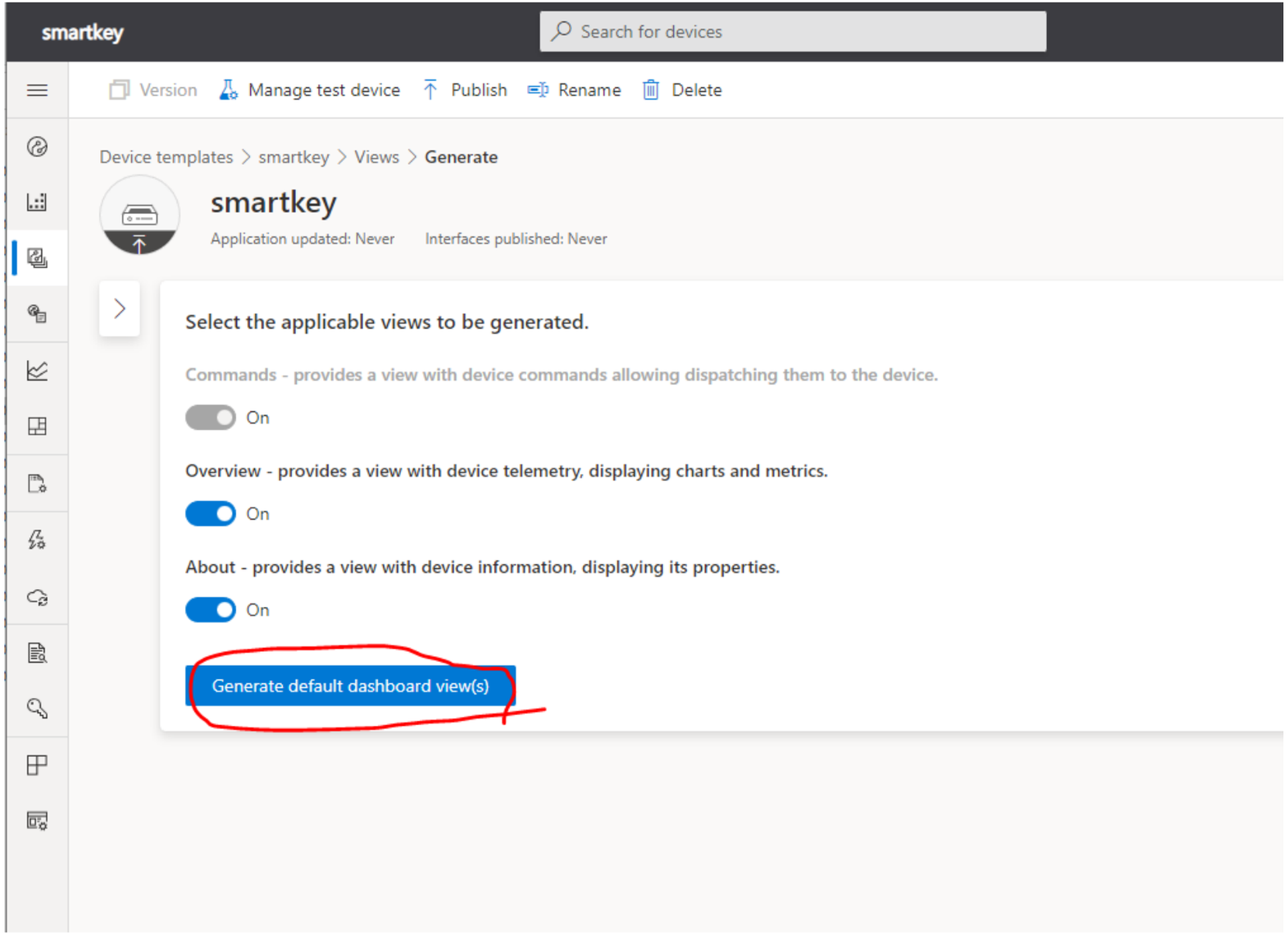
4) Device Template 제작



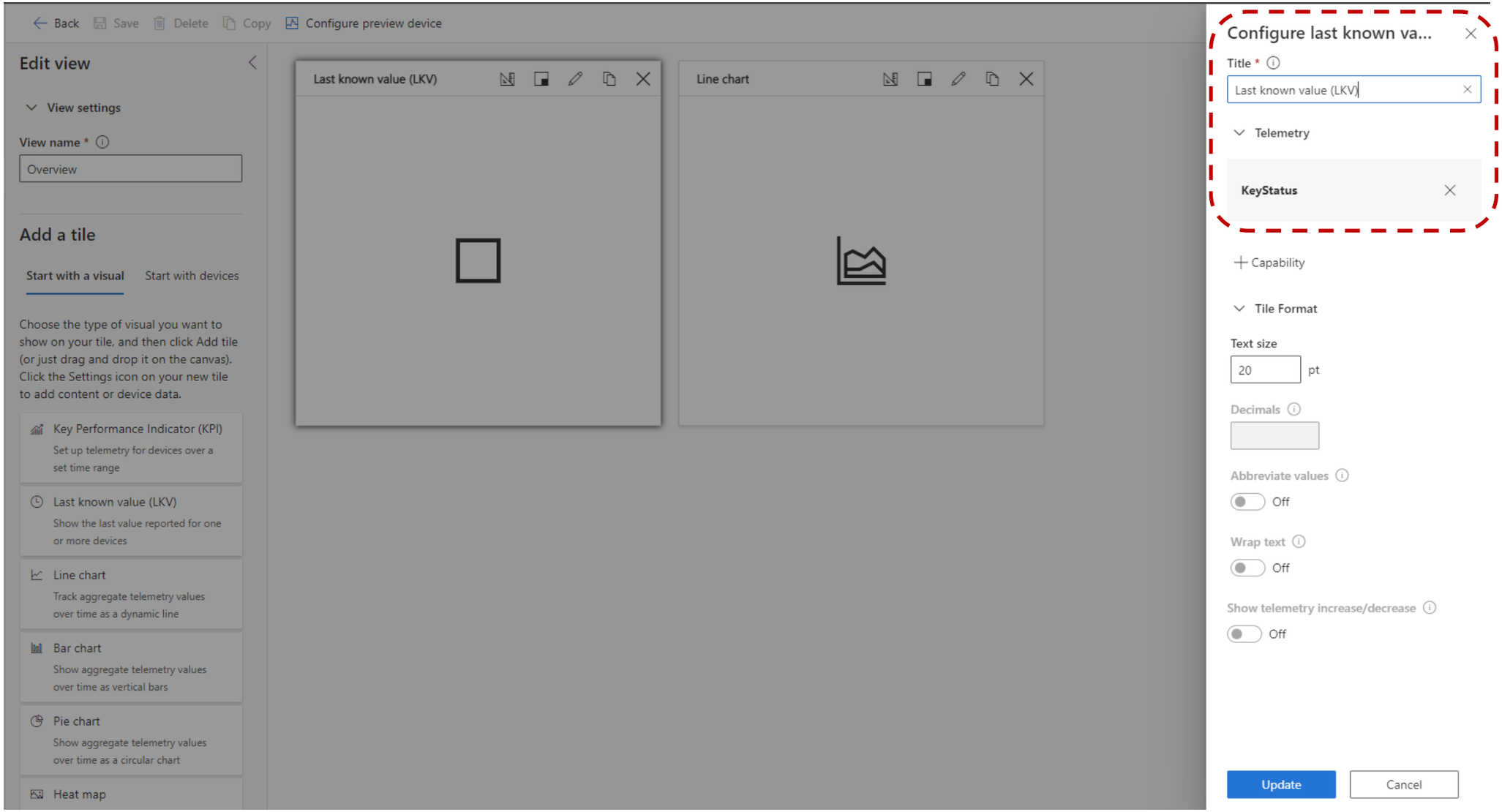
4) Device Template 제작



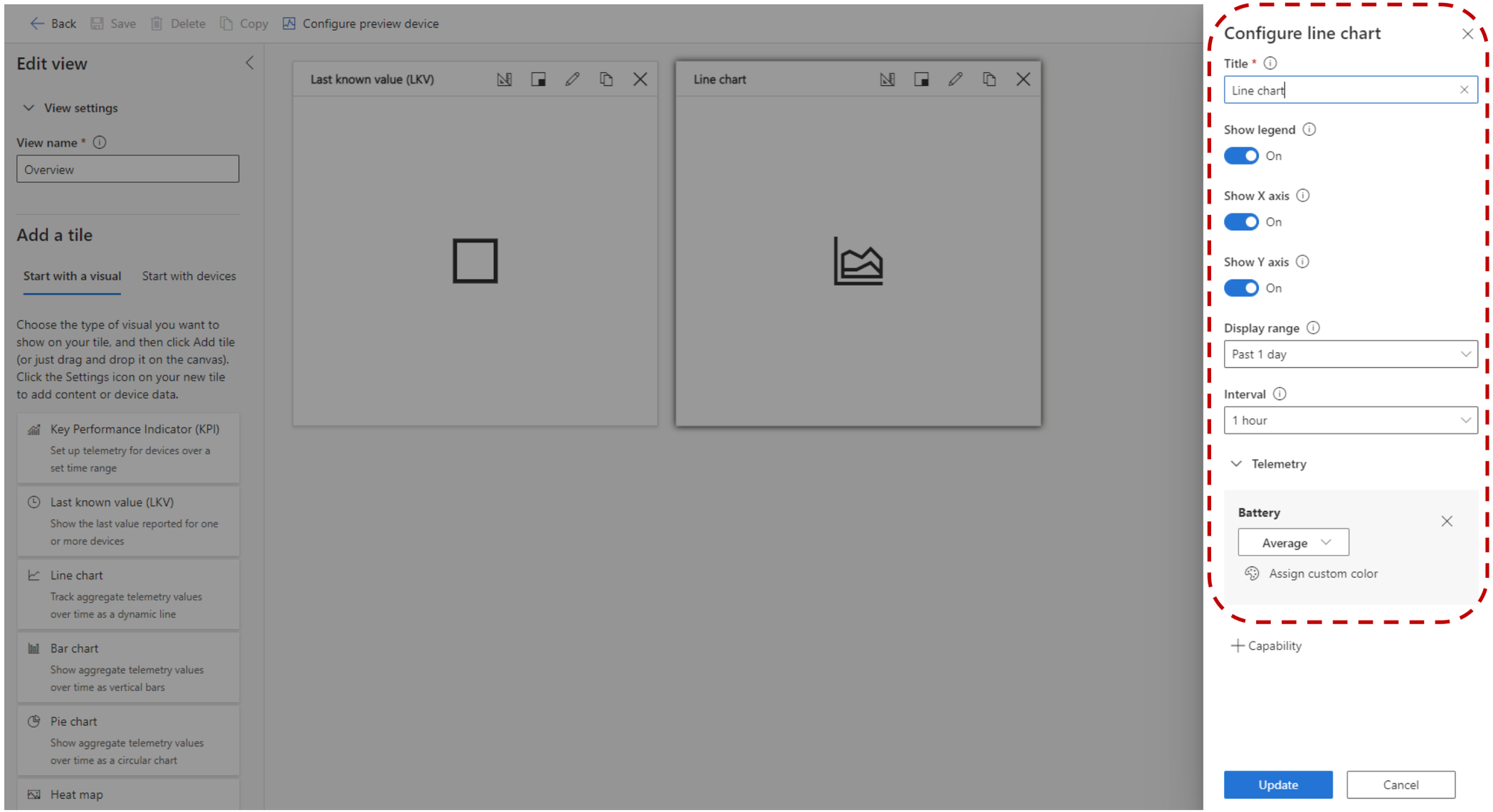
4) Device Template 제작



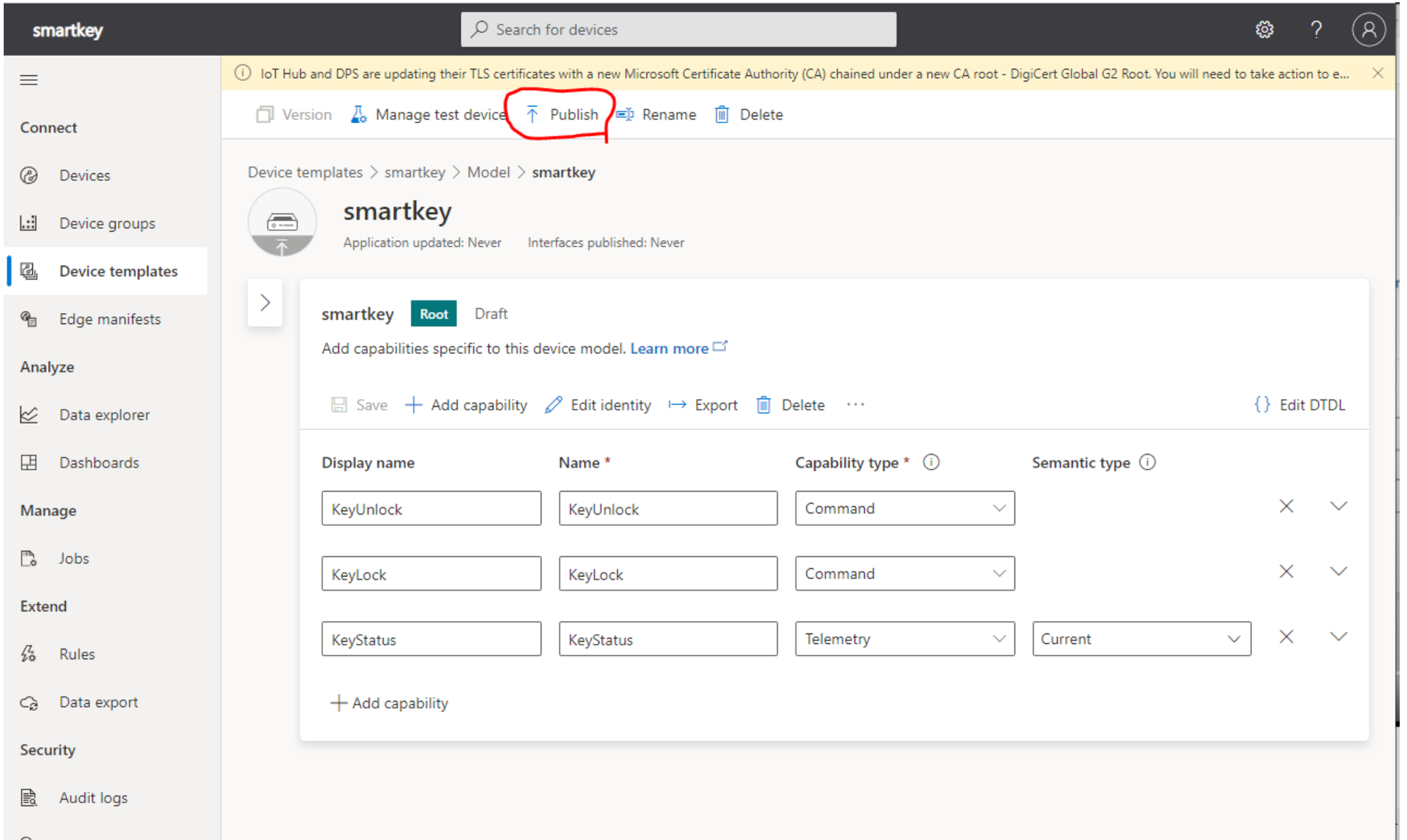
4) Device Template 제작



4) Device Template 제작

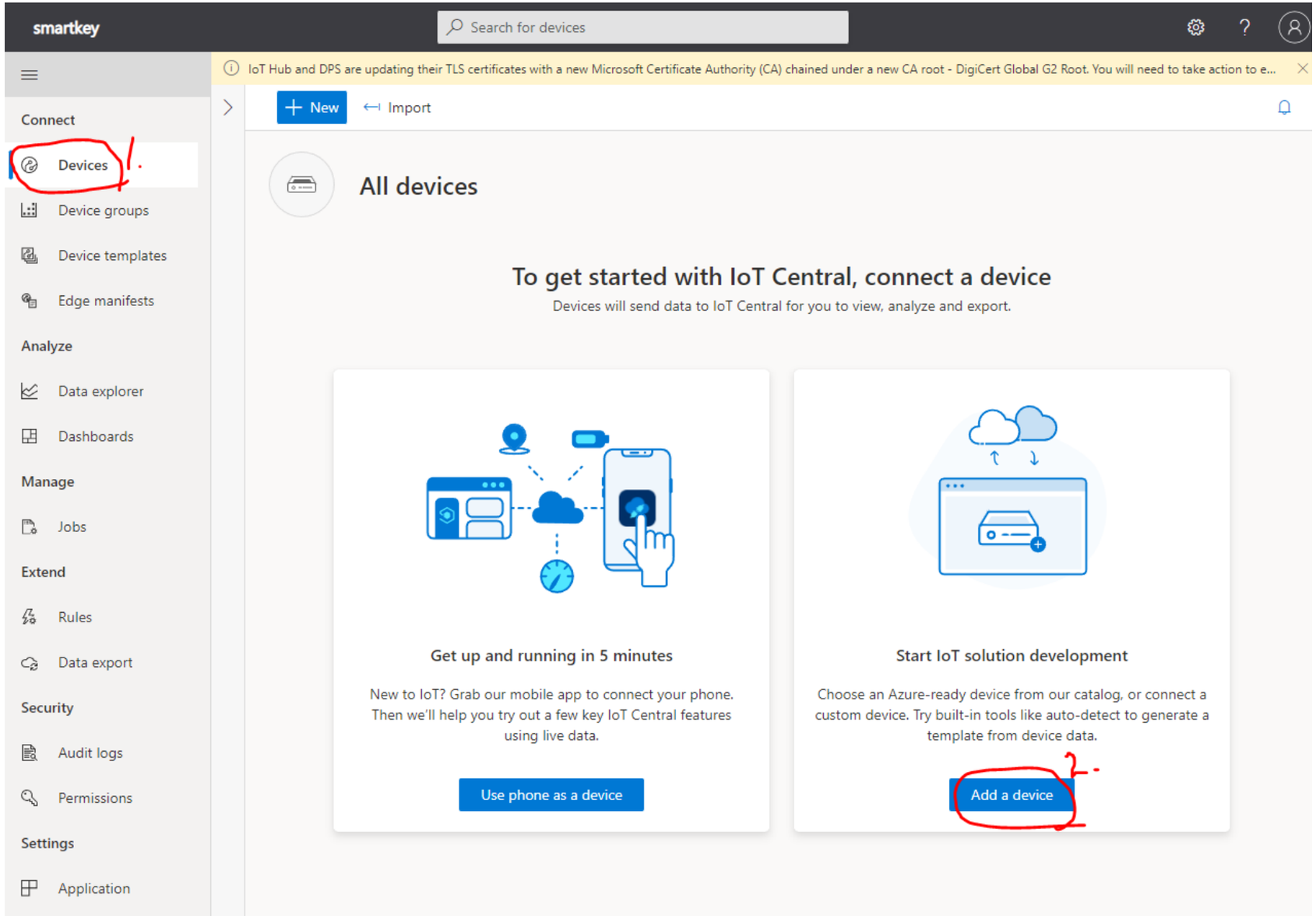


4) Device Template 제작



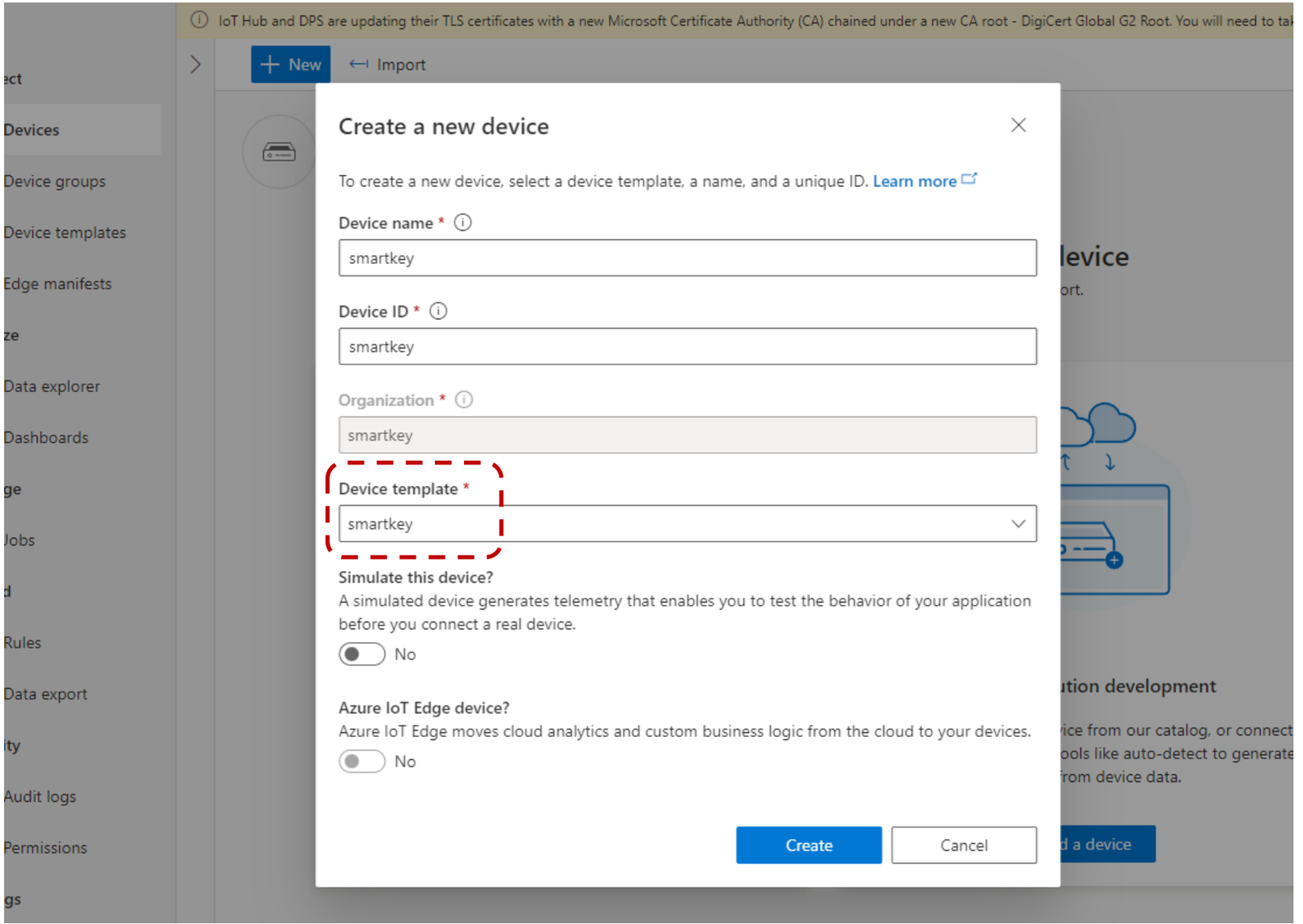
6. Azure IoT Central Cloud 설정

5) Device Template 적용

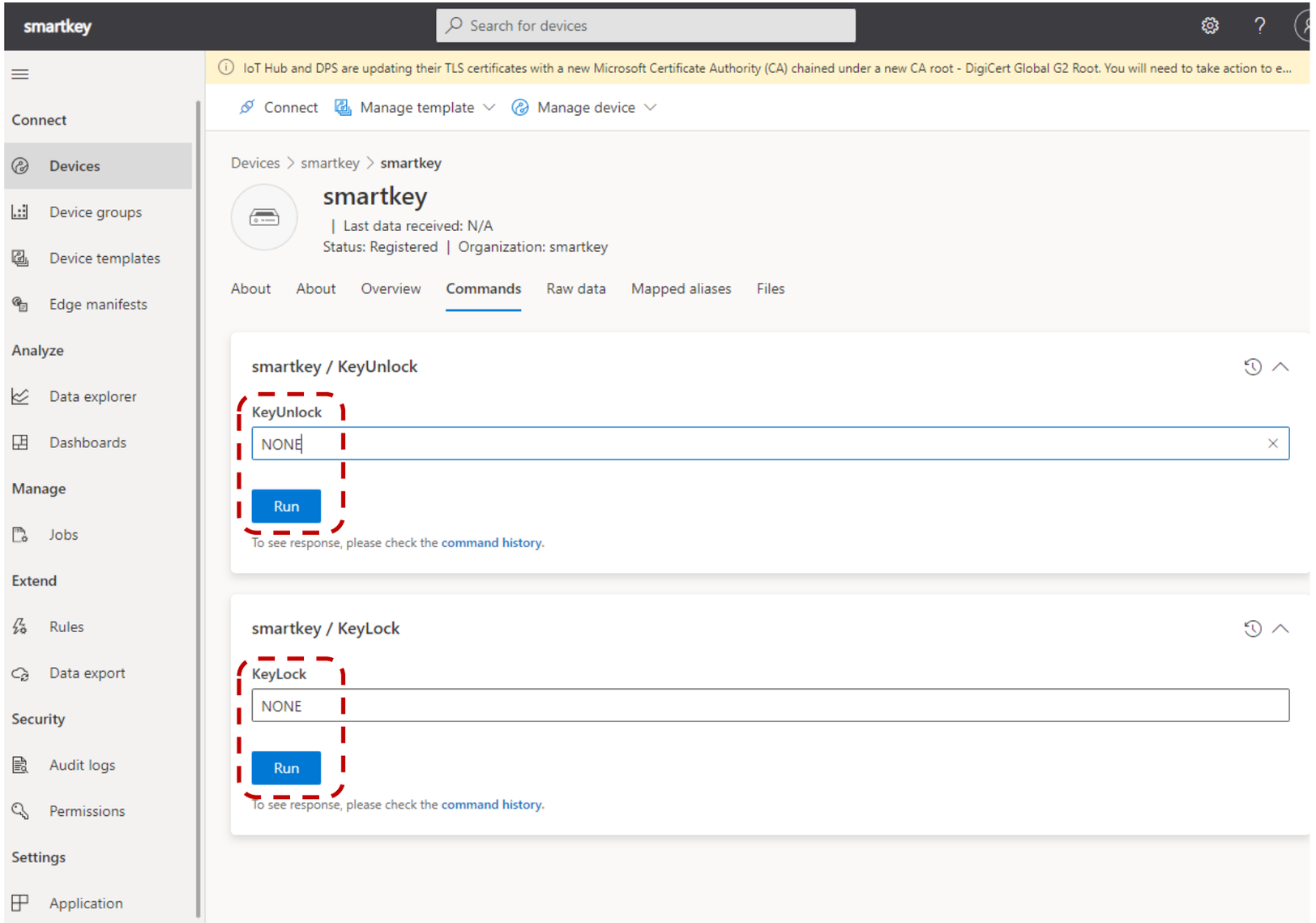


6. Azure IoT Central Cloud 설정

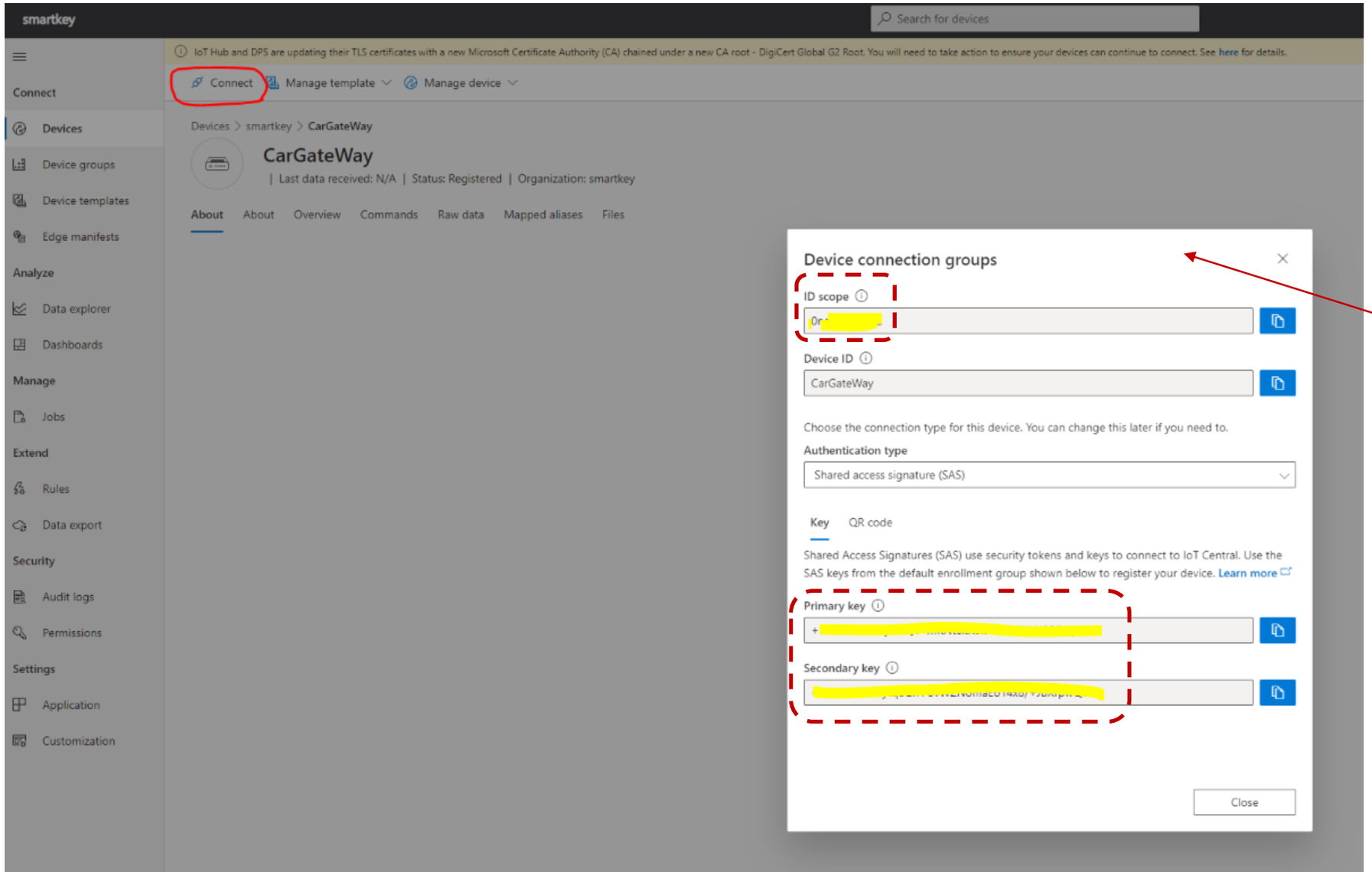
5) Device Template 적용



6) Commands 확인



7) Device 등록정보 확인



ID scope
Device ID
Primary key

펌웨어
소스코드에 입력

7. 펌웨어 연결 코드 입력, 모니터링 및 제어명령 추가

CodeZoo
www.codezoo.co.kr

1) Azure IoT Central 접속 정보 입력

```
iot.configs("", // ID scope
"", // Device ID
"" // Primary key
);
```

ID scope
Device ID
Primary key

펌웨어 소스코드에 입력

```
185  iot.configs(
186    "0ne[redacted]35C", // ID scope
187    "CarGateWay", // Device ID
188    "+19aaD[redacted]6VkU2FONpiA=" //Primary key
189  );
190
```

7. 펌웨어 연결 코드 입력, 모니터링 및 제어명령 추가

CodeZoo
www.codezoo.co.kr

2) 서보모터 각도 제어

```
68 void servoInit() {
69   myservo.attach(servoPin, 1000, 2000); // attaches the servo on pin 27 to the servo object
70   // using default min/max of 1000us and 2000us
71   // different servos may require different min/max settings
72   // for an accurate 0 to 180 sweep
73   for (pos = 0; pos <= 70; pos += 1) { // goes from 0 degrees to 70 degrees
74     // in steps of 1 degree
75     myservo.write(pos);    // tell servo to go to position in variable 'pos'
76     delay(5);             // waits 5ms for the servo to reach the position
77   }
78   myservo.detach();
79 }
80
81 void servoUp() {
82   myservo.attach(servoPin, 1000, 2000); // attaches the servo on pin 27 to the servo object
83   // using default min/max of 1000us and 2000us
84   // different servos may require different min/max settings
85   // for an accurate 0 to 180 sweep
86   for (pos = 70; pos <= 120; pos += 1) { // goes from 70 degrees to 120 degrees
87     // in steps of 1 degree
88     myservo.write(pos);    // tell servo to go to position in variable 'pos'
89     delay(5);             // waits 5ms for the servo to reach the position
90   }
91   for (pos = 120; pos >= 40; pos -= 1) { // goes from 120 degrees to 40 degrees
92     myservo.write(pos);    // tell servo to go to position in variable 'pos'
93     delay(5);             // waits 5ms for the servo to reach the position
94   }
95   myservo.detach();
96 }
97
98 void servoDown() {
99   myservo.attach(servoPin, 1000, 2000); // attaches the servo on pin 27 to the servo object
100  for (pos = 0; pos <= 70; pos += 1) { // goes from 0 degrees to 70 degrees
101    // in steps of 1 degree
102    myservo.write(pos);    // tell servo to go to position in variable 'pos'
103    delay(5);             // waits 5ms for the servo to reach the position
104  }
105  myservo.detach();
106 }
```

사용할 스마트키에 맞춰서 기구설계와 테스트를 진행하며 어느정도 각도로 좌우로 움직일지 설정

7. 펌웨어 연결 코드 입력, 모니터링 및 제어명령 추가

CodeZoo
www.codezoo.co.kr

3) Azure IoT Central로 보낼 데이터 설정

```
void setTelemetryValue(String name, int value) ;
void setTelemetryValue(String name, float value) ;
void setTelemetryValue(String name, double value) ;
void setTelemetryValue(String name, bool value) ;
void setTelemetryValue(String name, const String& value) ;
void setTelemetryValue(String name, JsonVariant value) ;

bool sendMessage() ; // 셋팅한 데이터를 클라우드로 전송
```

- ✓ 동일한 함수명으로 오버로딩 되어 있습니다. String으로 name을 쓰고 거기에 맞는 데이터 타입의 변수를 넣으면 됩니다.
- ✓ name과 type은 AzureIoTCentral에 사용하는 템플릿의 name과 type과 맞아야 정상적으로 데이터가 업로드됩니다.

```
float battery_voltage = readBattery();
iot.setTelemetryValue("Battery", battery_voltage);

iot.setTelemetryValue("KeyStatus", true);
iot.setTelemetryValue("KeyStatus", false);

iot.sendMessage();
```

7. 펌웨어 연결 코드 입력, 모니터링 및 제어명령 추가

4) Azure IoT Central 제어명령 처리 설정

```
191  iot.addCommandHandle("KeyUnlock", [](String payload) { // Add handle 'KeyUnlock' command
192    int valueInt = payload.toInt(); // Convart payload in String to Number (int)
193    servoDown();
194    delay(1000);
195    Serial.println("KeyUnlock");

206  iot.addCommandHandle("KeyLock", [](String payload) { // Add handle 'KeyLock' command
207    int valueInt = payload.toInt(); // Convart payload in String to Number (int)
208    servoUp();
209    delay(1000);
210    Serial.println("KeyLock");
```

- ✓ Azure 클라우드에서 해당 명령을 받았을때 처리하는 부분입니다. 다양한 명령을 추가하려면 위 형식으로 처리
- ✓ payload.toInt() 이 부분은 명령에 따라오는 payload가 있을때 각각의 데이터타입에 맞춰서 변환해 주는 부분 (KeyLock, KeyUnlock에서 payload를 사용하지 않지만 명령+설정값 형태로 제어할 경우 사용)

8. 테스트 결과

CodeZoo
www.codezoo.co.kr

1) 데이터 실제 사용량 (with Vodafone)

2022-12-24 2:57 ~ 2022-12-25 1:16 22 hour(s), 19 minute(s)

Uploaded 854.25 KB - 0 B test, 854.25 KB live / Downloaded 758.32 KB - 0 B test, 758.32 KB live

22시간 기준 데이터 사용량 약 1.58MB

(Connected & Battery Voltage report every hour & Door Test a little)

2023-01-07 12:33 2023-01-08 8:47 20 hour(s), 14 minute(s)

Uploaded 794.78 KB - 0 B test, 794.78 KB live Downloaded 761.5 KB - 0 B test, 761.5 KB live

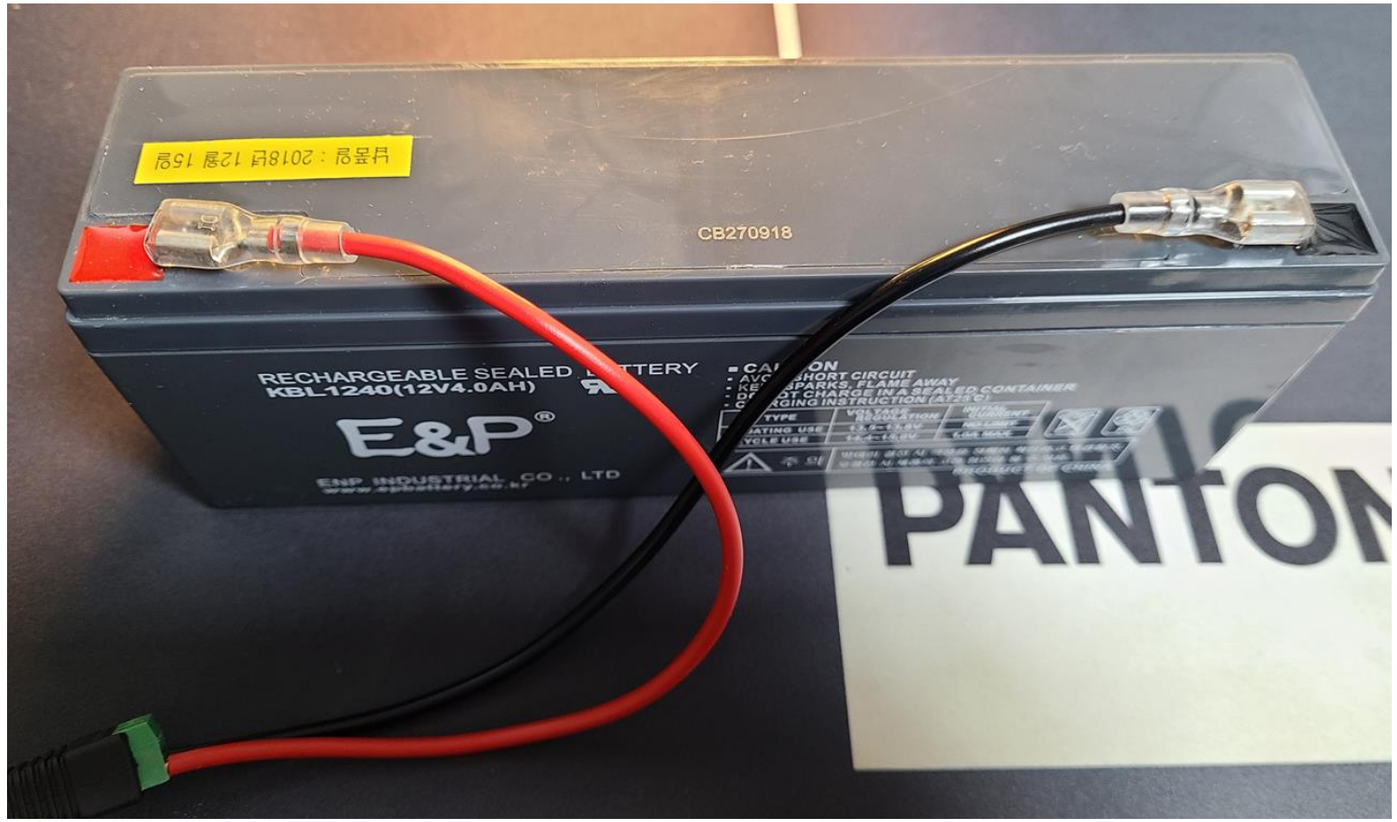
20시간 기준 데이터 사용량 약 1.56MB

(Connected & Battery Voltage report every hour & Door Test a little)

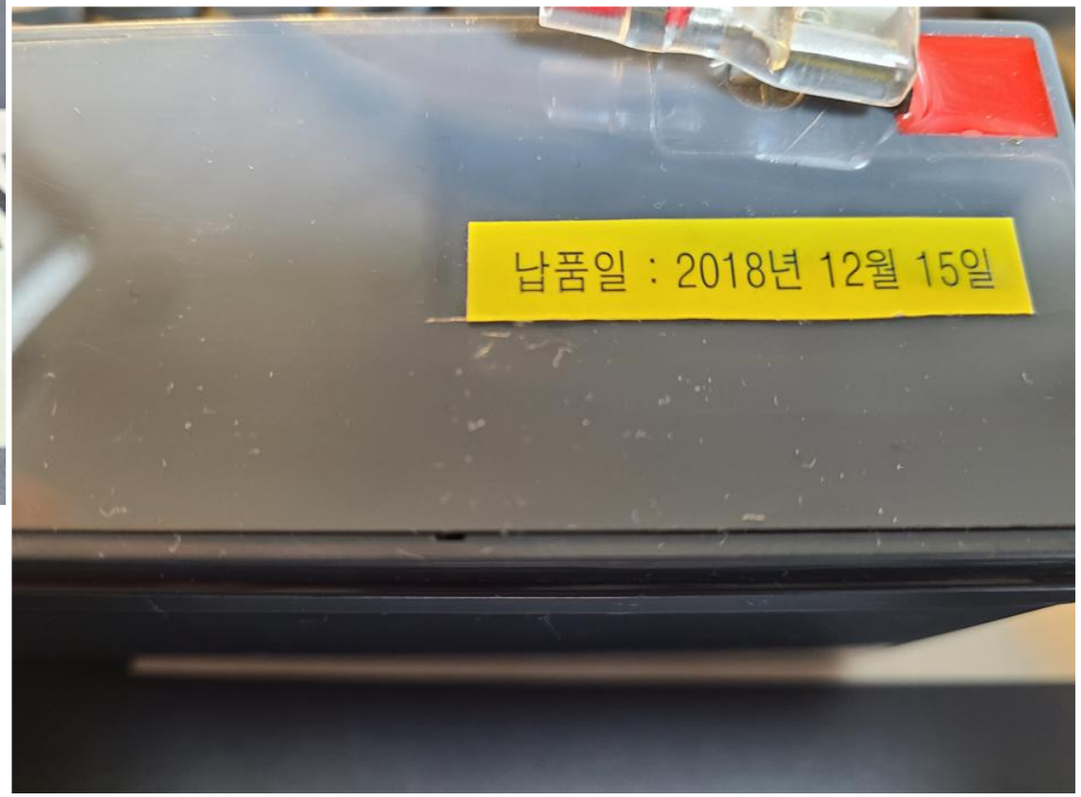
8. 테스트 결과

CodeZoo
www.codezoo.co.kr

2) 배터리 사용량 (12V, 4000mAh, *배터리에 따라 측정값이 달라질 수 있음*)



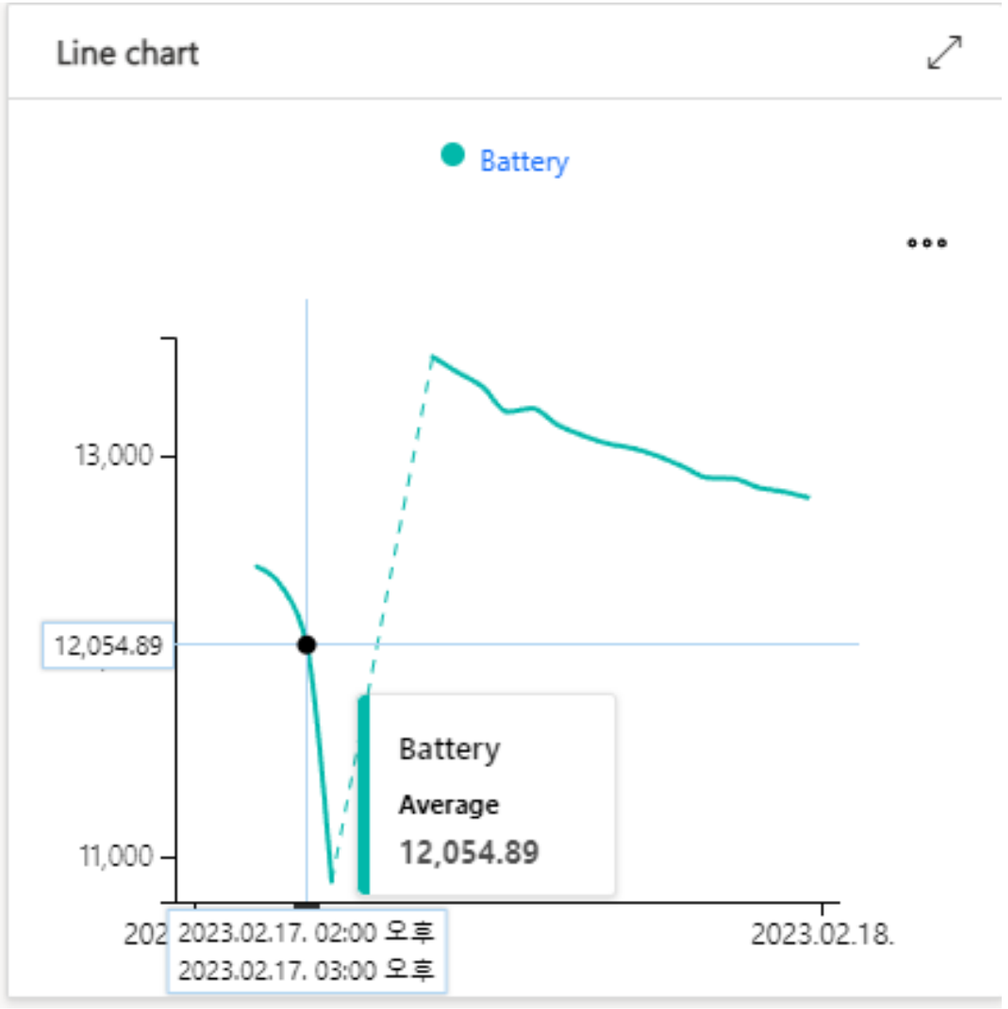
ESP32 동작클럭 : 80Mhz
LCD : OFF
Servo Motor : Ready
Battery Voltage Sensing : Ready

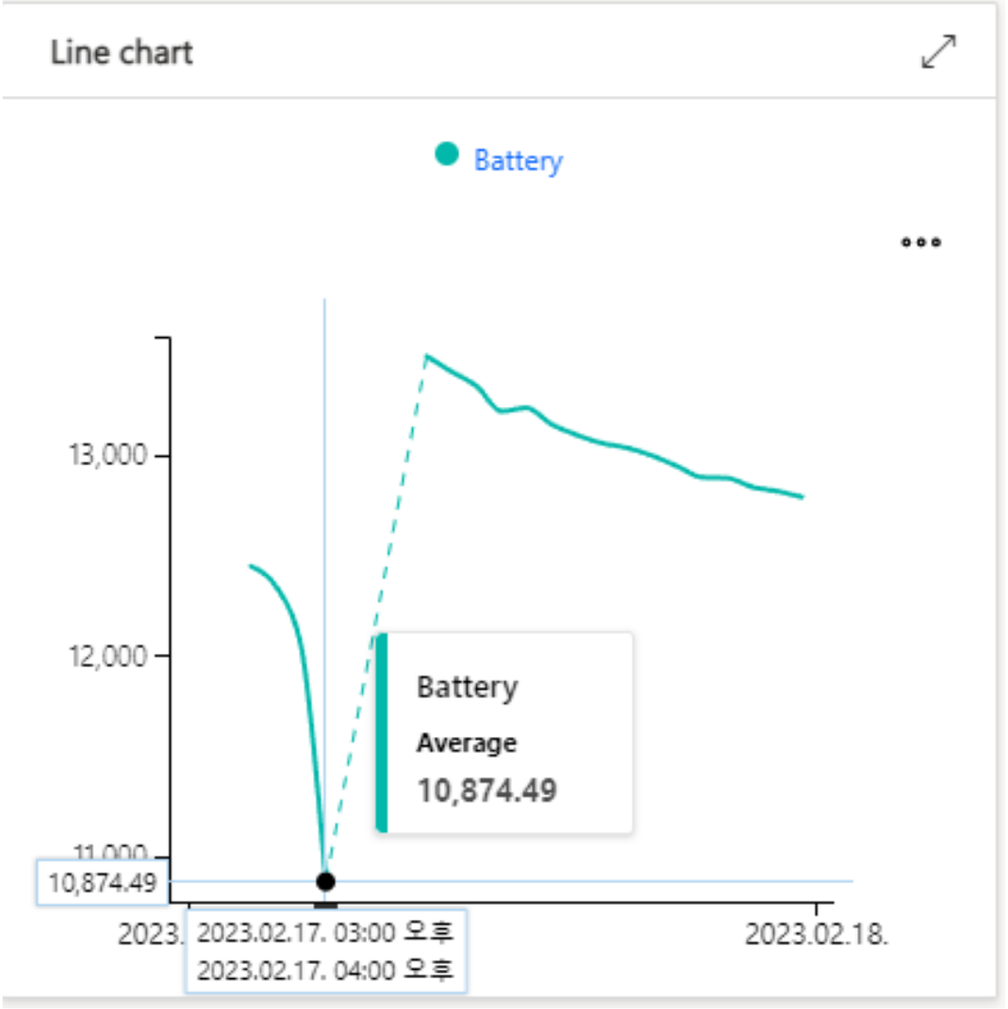


8. 테스트 결과

CodeZoo
www.codezoo.co.kr

2) 배터리 사용량 (12V, 4000mAh)



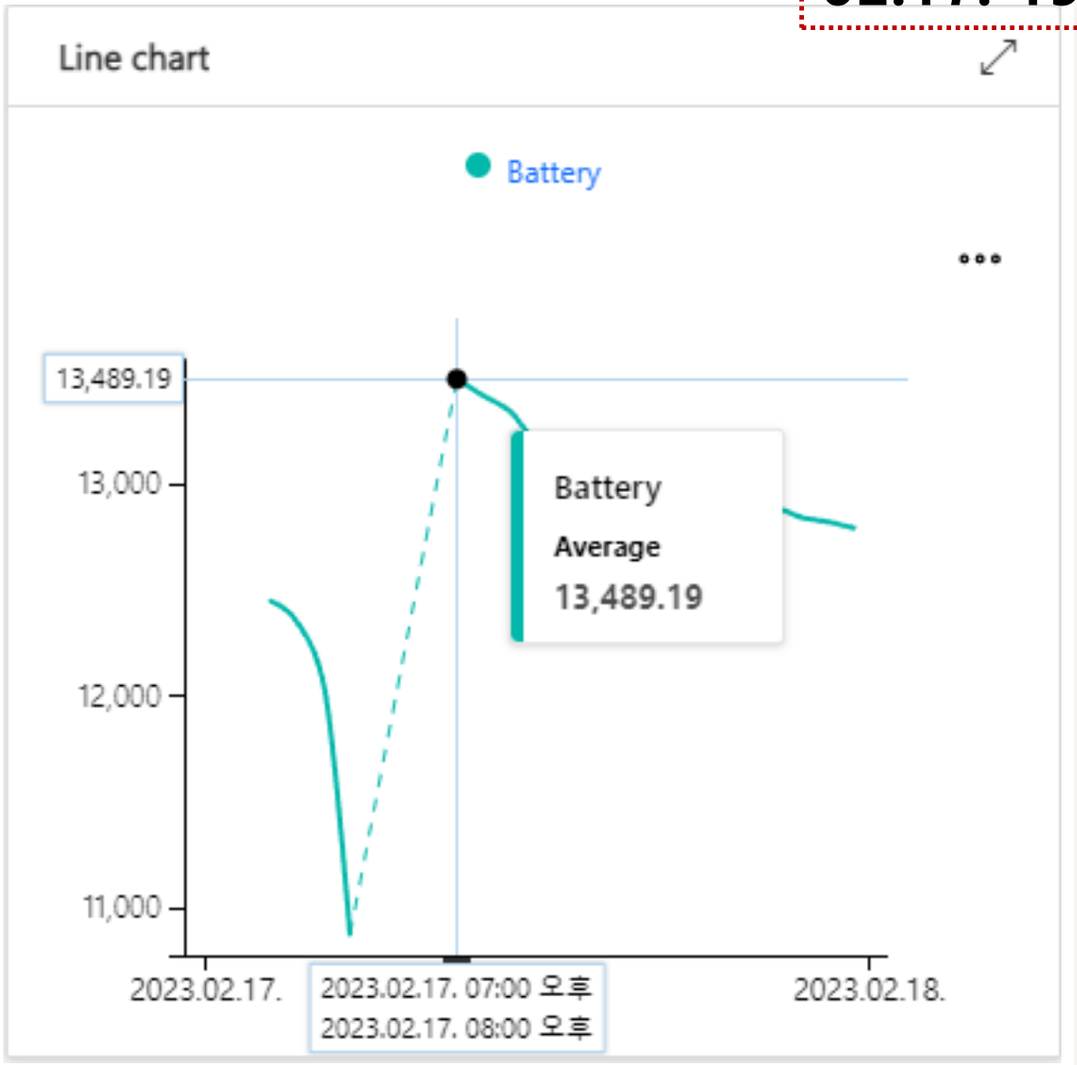


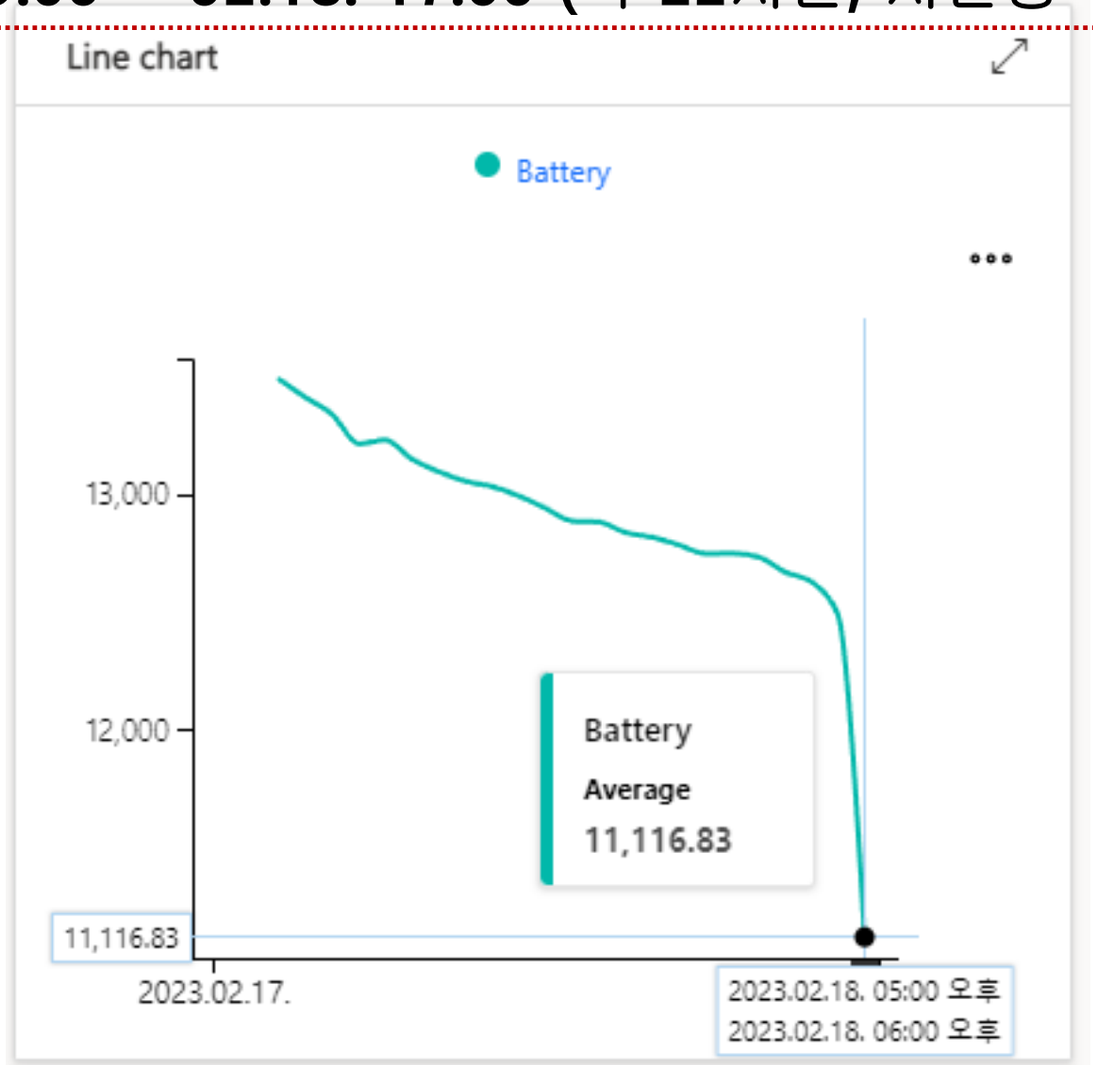
8. 테스트 결과

CodeZoo
www.codezoo.co.kr

2) 배터리 사용량 (12V, 4000mAh)

02.17. 19:00 ~ 02.18. 17:00 (약 22시간, 시간당 180mAh)



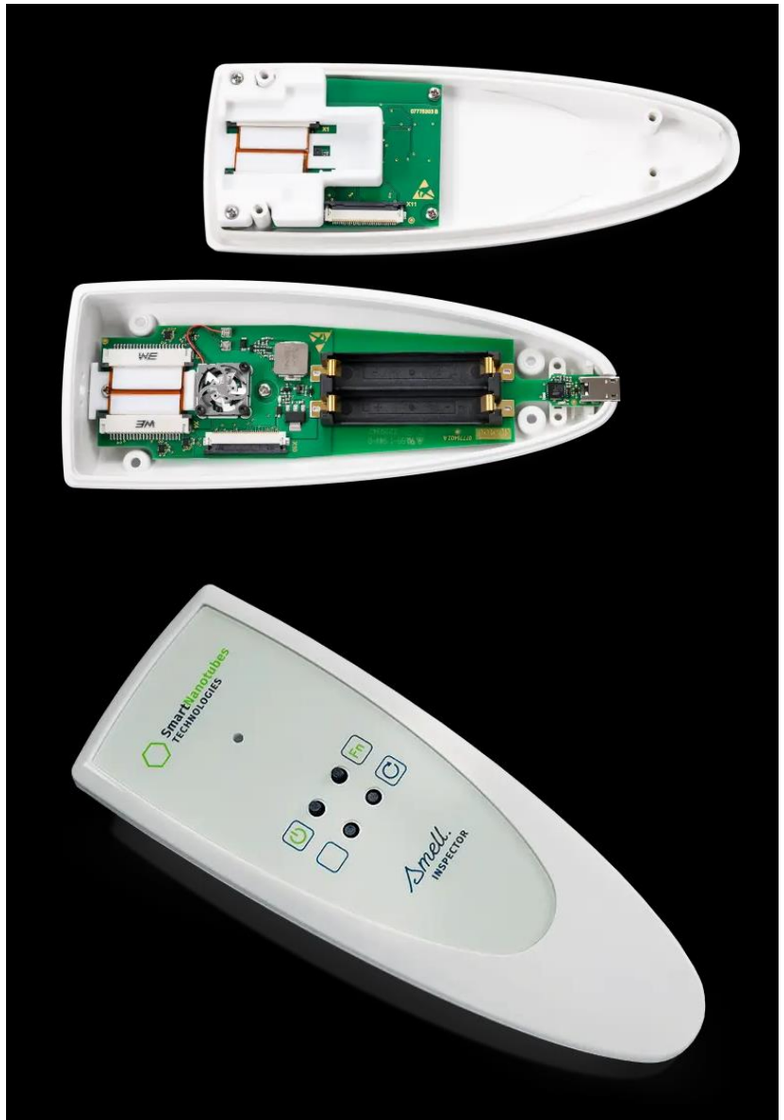


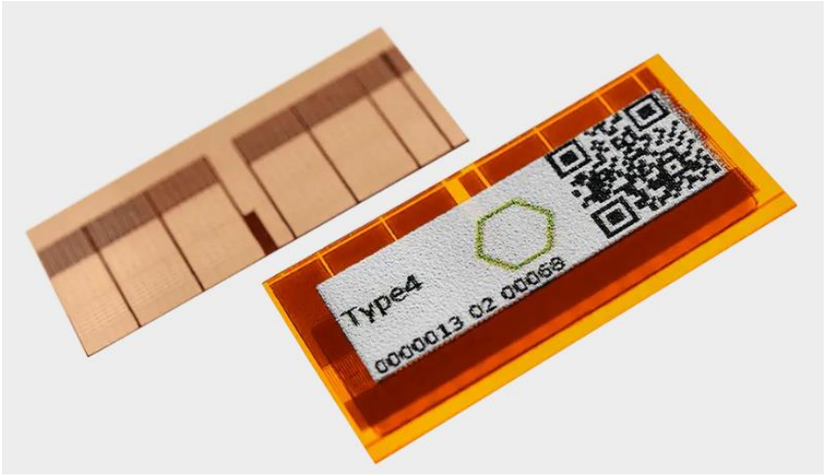
9. More Connected Car

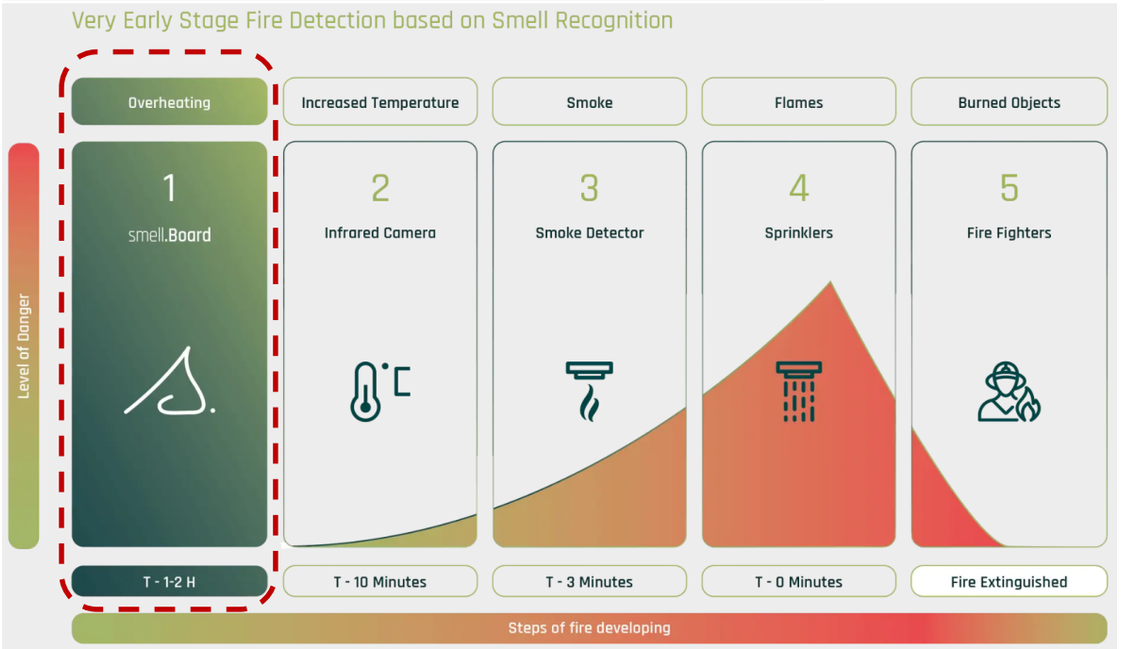
CodeZoo
www.codezoo.co.kr

1) 차량 내 특정한 냄새 인식 (신소재 센서)

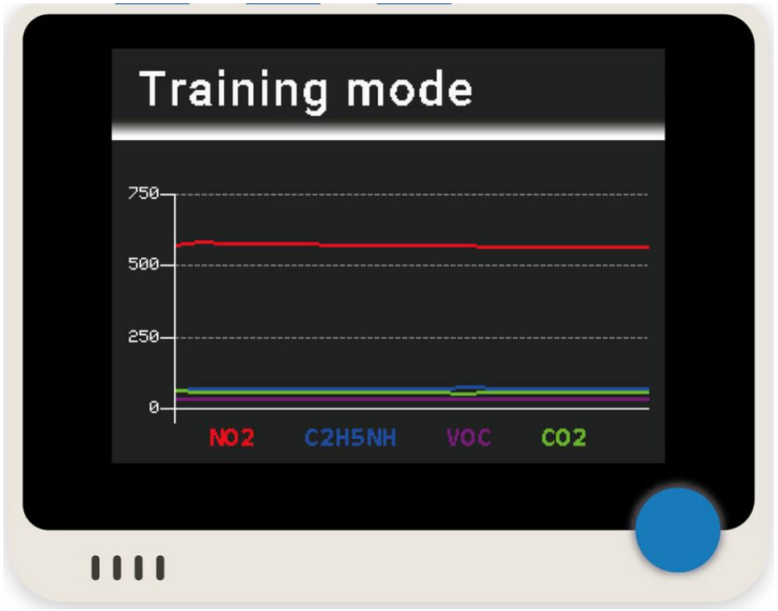
출처 : https://smart-nanotubes.com/

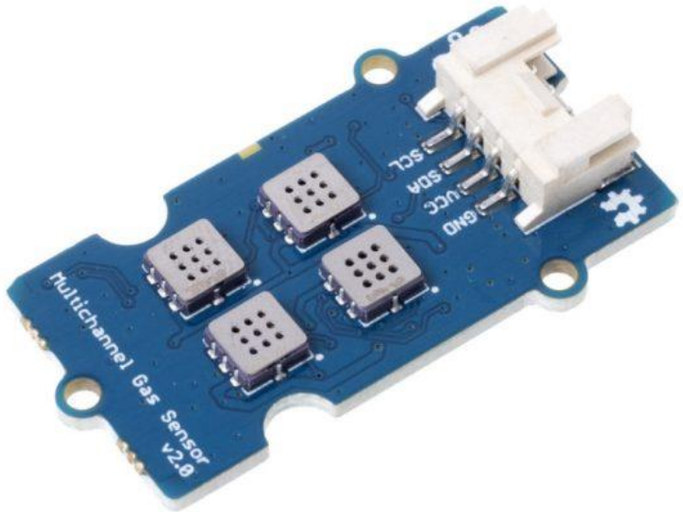






2) 차량 내 특정한 냄새 인식 (딥러닝을 활용한 화학센서)





Last training performance (validation set)

ACCURACY	LOSS
97.1%	0.06

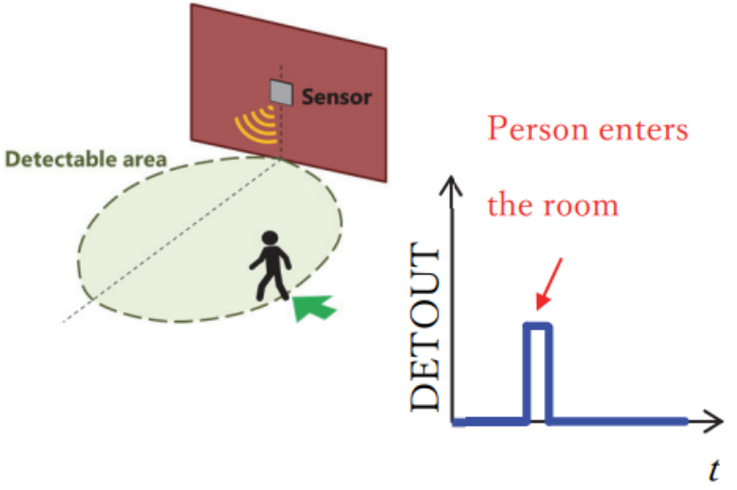
Confusion matrix (validation set)

	AMBIENT	COFFEE
AMBIENT	98.3%	1.7%
COFFEE	5.7%	94.3%
F1 SCORE	0.98	0.95

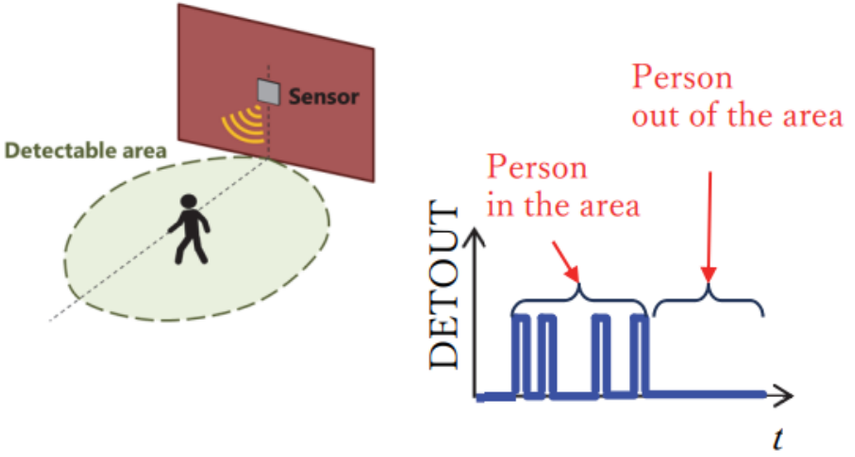
출처 : https://makezine.com/projects/second-sense-build-an-ai-smart-nose/

3) 차량 주위 탐지 (Radar 24/60GHz)

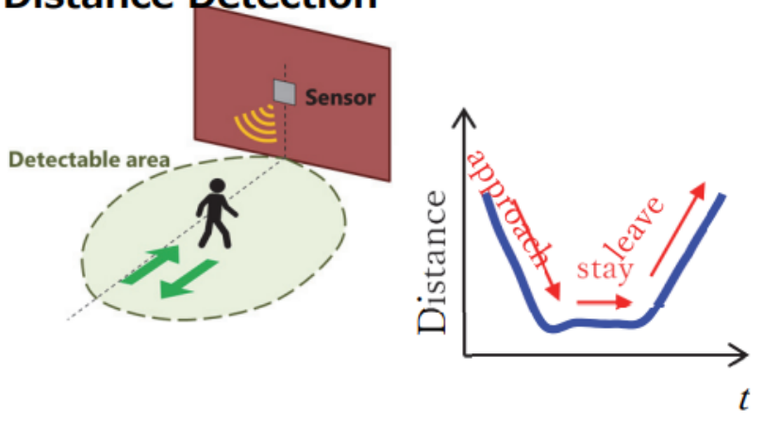
1-1. Entry Motion Detection



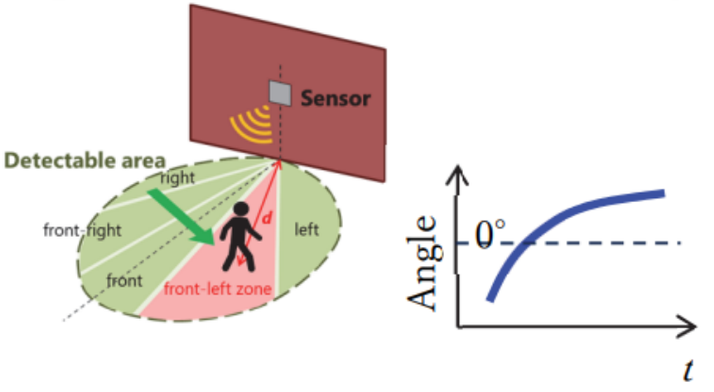
1-2. Presence Detection



2. Distance Detection

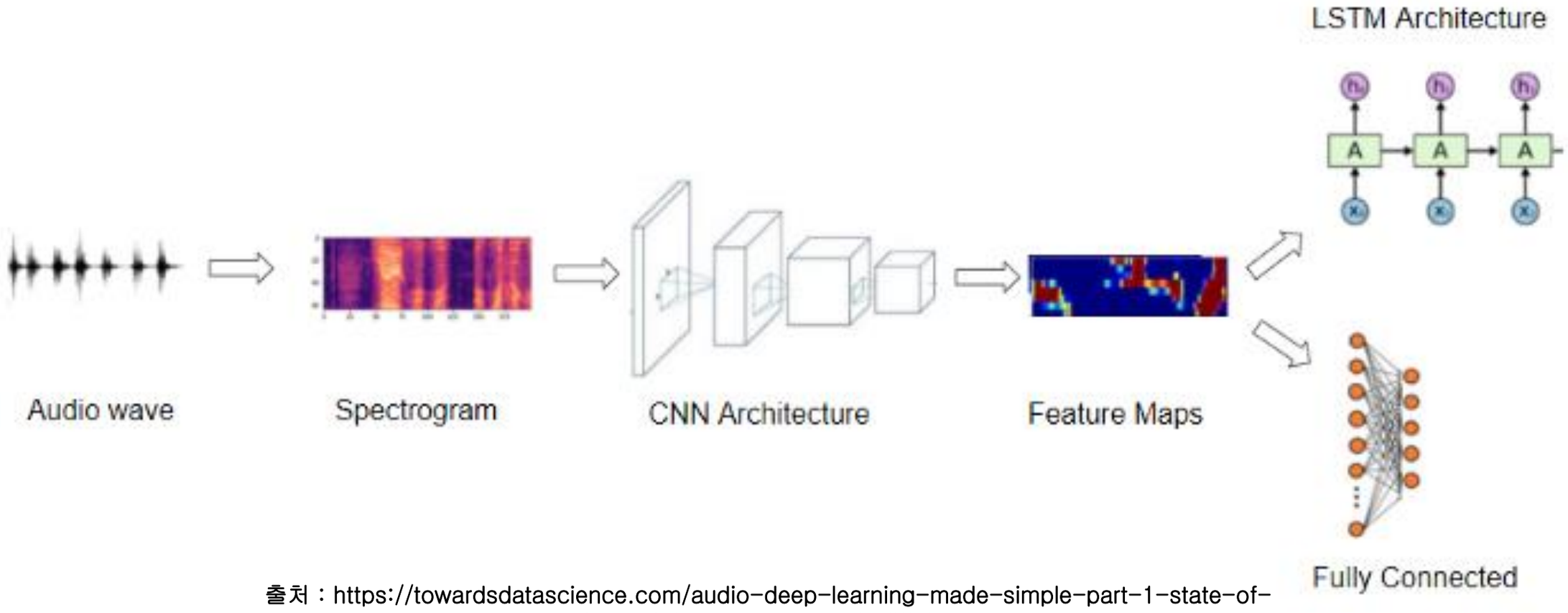


3. Angle Detection (SC1233AR3 Only)



출처 : https://www.socionext.com/en/pr/sn_pr20191003_01e.pdf

4) 차량 내 특정소음 또는 진동 인식 (Edge AI)



출처 : https://towardsdatascience.com/audio-deep-learning-made-simple-part-1-state-of-the-art-techniques-da1d3dff2504

5) More Idea

anything you want

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