

W E L C O M E

TO *Fabulous*

# TECHORAMA

UTRECHT

Copy The World With Azure  
Digital Twins

Matthijs van der Veer  
Xpirit



✓ Checking if windows resolves the issue

[Browse files](#)

⌚ main (#4)



MatthijsvdVeer committed 6 days ago

1 parent 924943c

commit 2ec746ccb78b6657bf04697b586f27173c01d20e

# Copy The World With Azure Digital Twins



# Agenda

- What is a Digital Twin?
- Azure Digital Twins
- Building a digital twin
- Copy. The. World.
- Q&A

A photograph of Earth at night from a high vantage point, likely space. The planet is mostly dark blue and black, representing oceans and landmasses. Numerous glowing yellow and white spots represent city lights, concentrated in large urban areas like North America and Europe. A bright green aurora borealis or southern lights arc across the upper portion of the image. The horizon line is visible, separating the dark atmosphere from the bright stars of the background.

A Digital Twin?

A large, semi-transparent white text box is centered over a background image of Earth at night as seen from space. The background shows the curvature of the planet, city lights concentrated along coastlines and in major urban areas, and a layer of clouds or haze. The text is in a clean, sans-serif font.

A Connected,  
Digital Representation  
Of A Physical  
Environment

A night-time satellite view of Earth from space, showing city lights and clouds.

A Connected,  
Digital Representation  
Of A Physical  
Environment

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Digital Representation  
Of A Physical  
Environment

A nighttime satellite view of Earth from space, showing city lights and auroras.

# Azure Digital Twins

# Three Pillars: Models



# Three Pillars: Models

Room

Properties:

- Name
- Co2Level
- Temperature



# Three Pillars: Models

Room

Properties:

- Name
- Co2Level
- Temperature

Chair

Properties:

- Row
- Number
- Occupied





```
{  
  "@id": "dtmi:digitaltwins:ctw:Room;1",  
  "@type": "Interface",  
  "contents": [  
    {  
      "@type": "Property",  
      "name": "name",  
      "schema": "string"  
    },  
    {  
      "@type": "Property",  
      "name": "co2Level",  
      "schema": "int"  
    },  
    {  
      "@type": "Property",  
      "name": "temperature",  
      "schema": "double"  
    },  
  ],  
  "description": {  
    "en": "Space that can be occupied or where something can be done."  
  },  
  "displayName": {  
    "en": "Room"  
  },  
  "@context": "dtmi:dtdl:context;2"  
}
```



# **Three Pillars: Twins**



# Three Pillars: Twins

## Room

- Name: Room 8
- Co2: 800
- Temperature: 21.4



# Three Pillars: Twins

## Room

- Name: Room 8
- Co2: 800
- Temperature: 21.4

## Chair

- Row: 1
- Number: 2
- Occupied: false

## Chair

- Row: 1
- Number: 1
- Occupied: true

## Chair

- Row: 1
- Number: 3
- Occupied: true



# Three Pillars: Relationships



# Three Pillars: Relationships

Room

Properties:

- Name
- Co2Level
- Temperature

Relationships:

- Contains: Chair



# Three Pillars: Relationships

Room

Properties:

- Name
- Co2Level
- Temperature

Relationships:

- Contains: Chair

Chair

Properties:

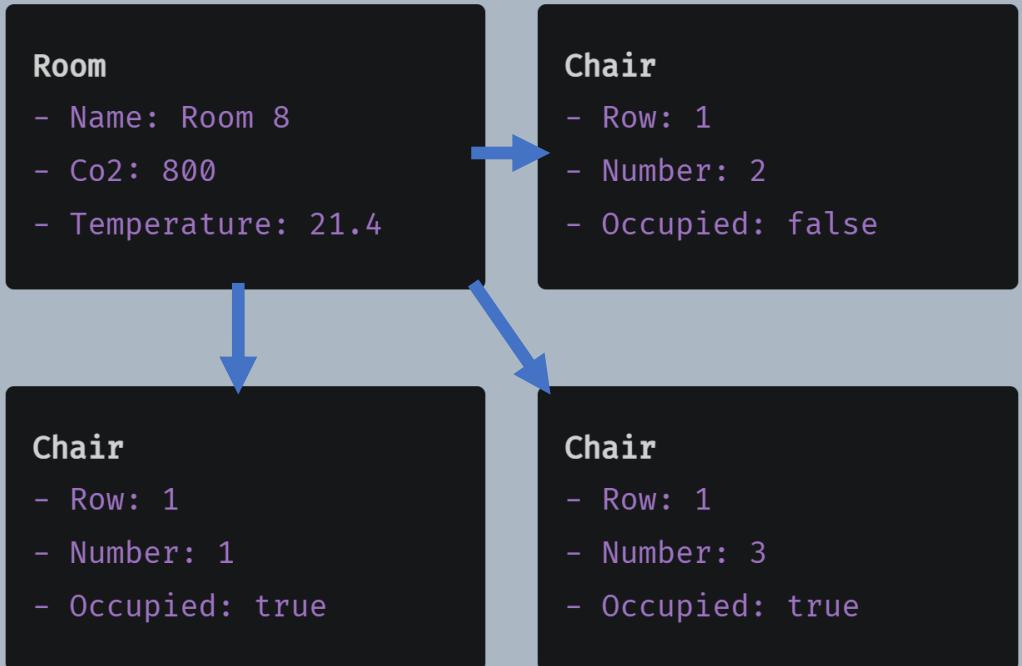
- Row
- Number
- Occupied

Relationships:

- ContainedBy: Room



# Three Pillars: Twins





## QUERY EXPLORER

Saved Queries

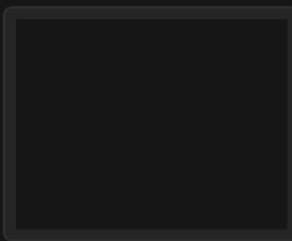
SELECT \* FROM DIGITALTWINS

Overlay results 

Run Query



## TWIN GRAPH MODEL GRAPH

 name



## QUERY EXPLORER

Saved Queries

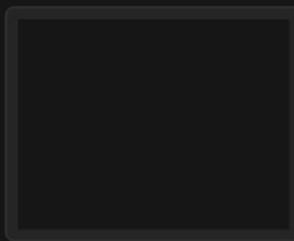
SELECT \* FROM DIGITALTWINS

Overlay results 

Run Query



## TWIN GRAPH MODEL GRAPH

 name



## QUERY EXPLORER

Saved Queries

SELECT \* FROM DIGITALTWINS

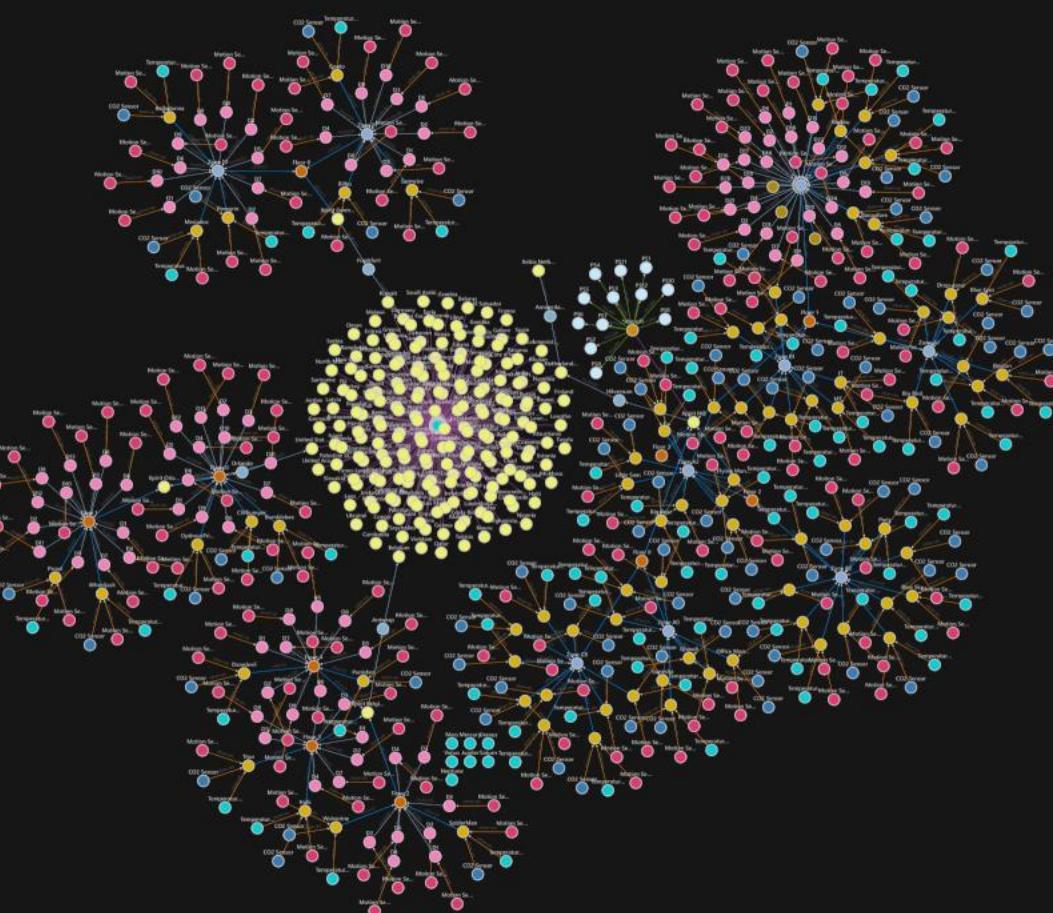
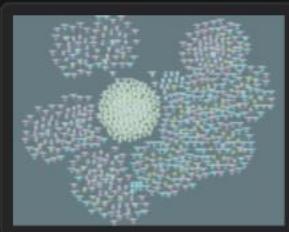
Overlay results 

Run Query



## TWIN GRAPH

## MODEL GRAPH

 name

# Where does this chair go?

```
SELECT rooms from DIGITALTWINS rooms  
JOIN chairs RELATED rooms.contains  
WHERE chairs.$dtId = 'chair-1'
```

# Find me an empty seat

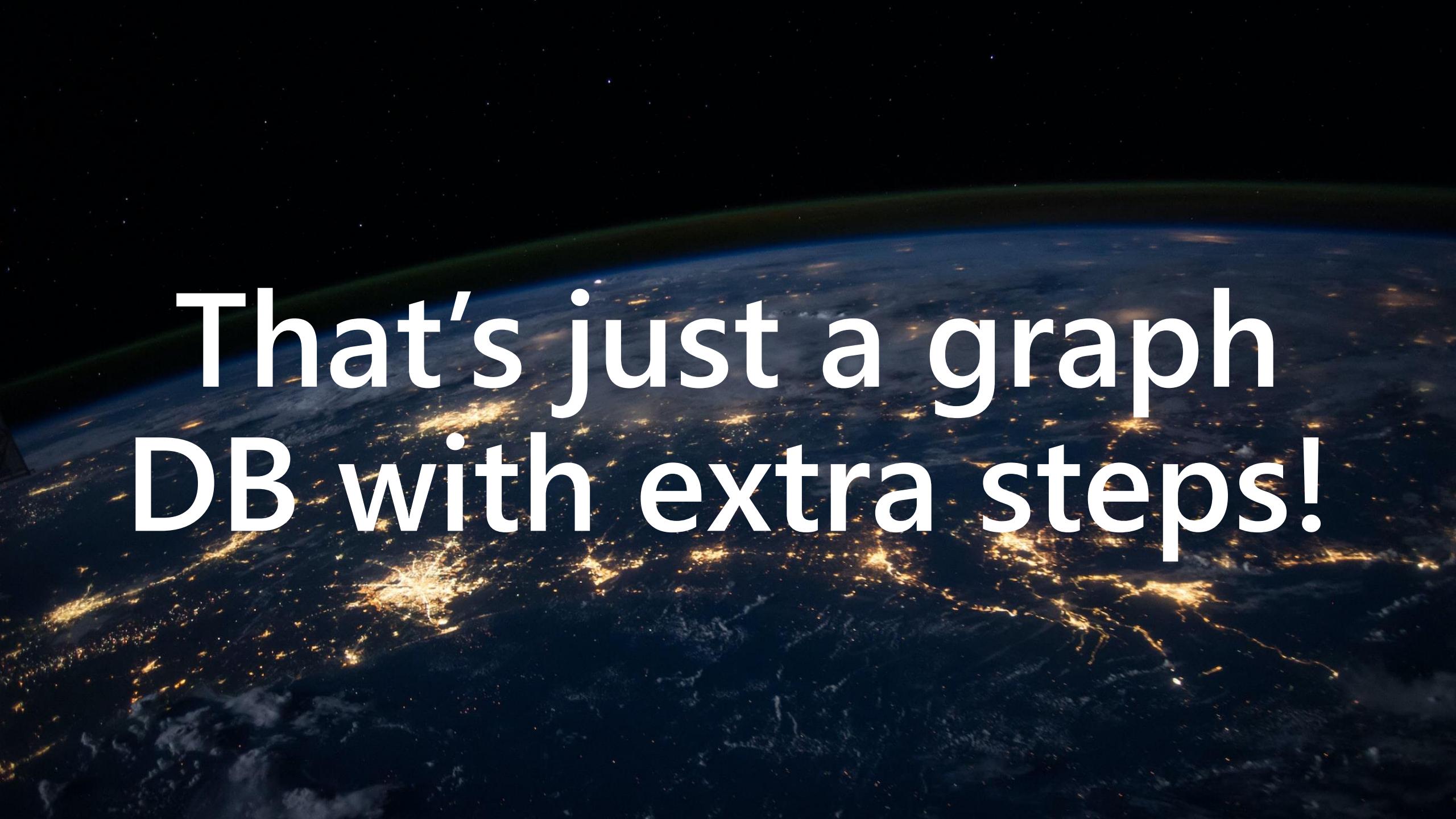
```
SELECT chairs FROM DIGITALTWINS rooms  
JOIN chairs RELATED rooms.contains  
WHERE chairs.occupied = false  
AND rooms.$dtId = 'room-8'
```

# All the chairs in this building

```
SELECT chairs FROM DIGITALTWINS buildings  
JOIN rooms RELATED buildings.contains  
JOIN chairs RELATED rooms.contains  
WHERE buildings.$dtId = 'building-1'
```

# All the chairs in this building

```
SELECT chairs FROM DIGITALTWINS  
  
MATCH (buildings)-[*1..3]→(chairs)  
  
WHERE IS_OF_MODEL(chairs, 'dtmi:digitaltwins:ctw:Chair;1')  
  
AND buildings.$dtId = 'building-1'
```

A night-time satellite view of Earth from space, showing city lights and auroras.

That's just a graph  
DB with extra steps!



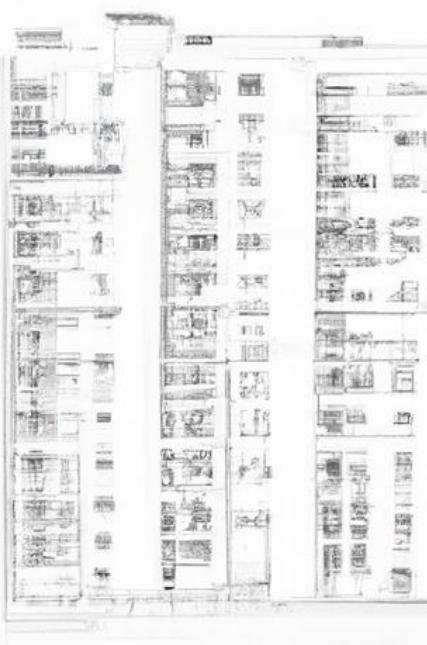
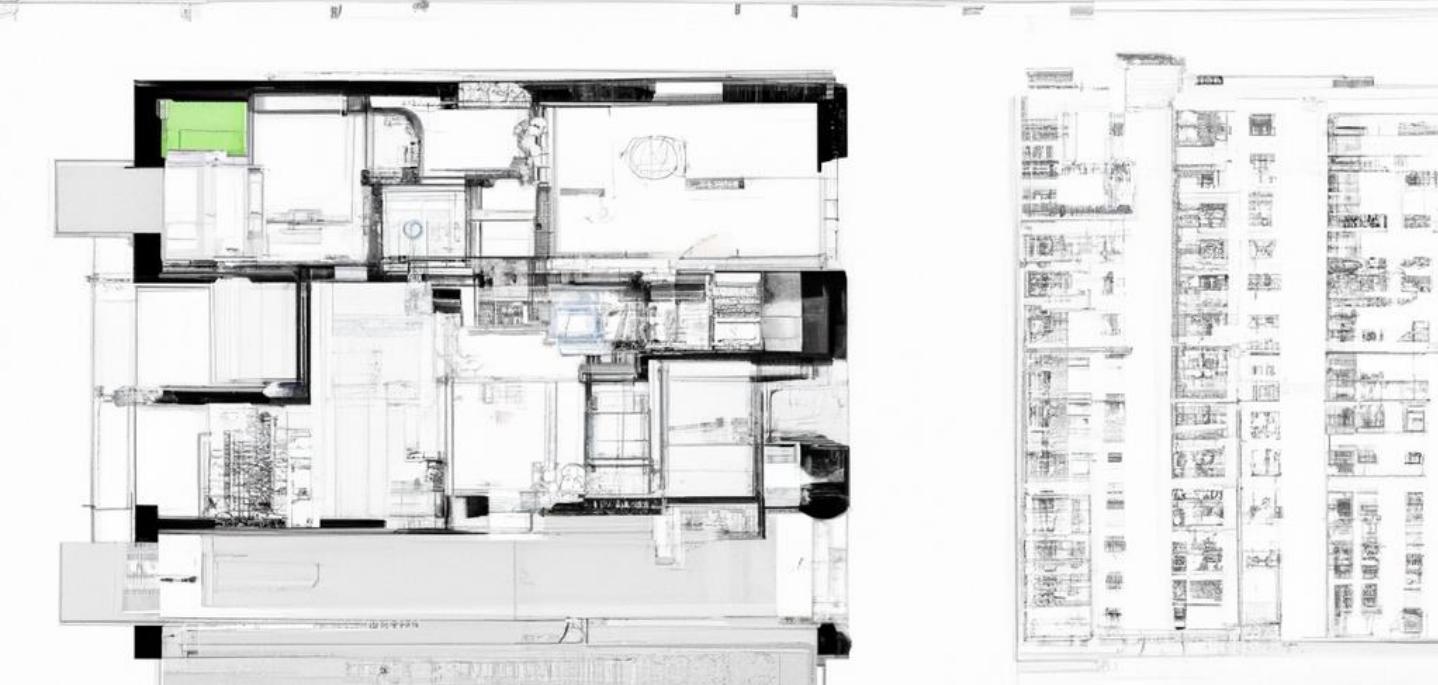
STOP



What  
Even  
Is A  
Building?



DALL-E  
“Child’s drawing of a house”



DALL-E  
“professional schematics of  
a corporate building”

A nighttime satellite view of Earth from space, showing city lights and auroras.

Adopt  
Convert  
Author

A nighttime satellite view of Earth from space, showing city lights and auroras.

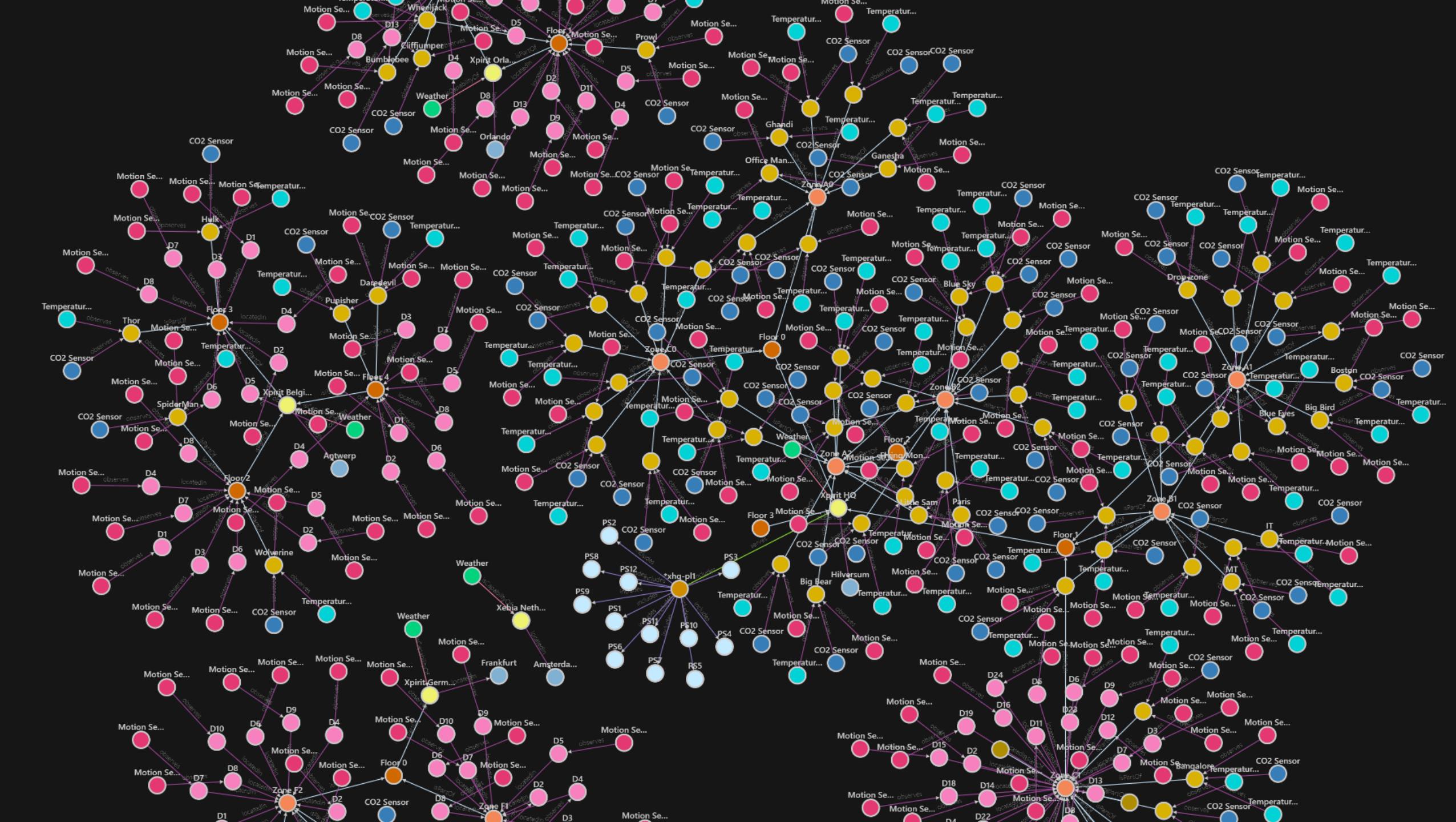
Adopt  
Convert  
Author

A nighttime satellite view of Earth from space, showing city lights and auroras.

Adopt  
Convert  
Author

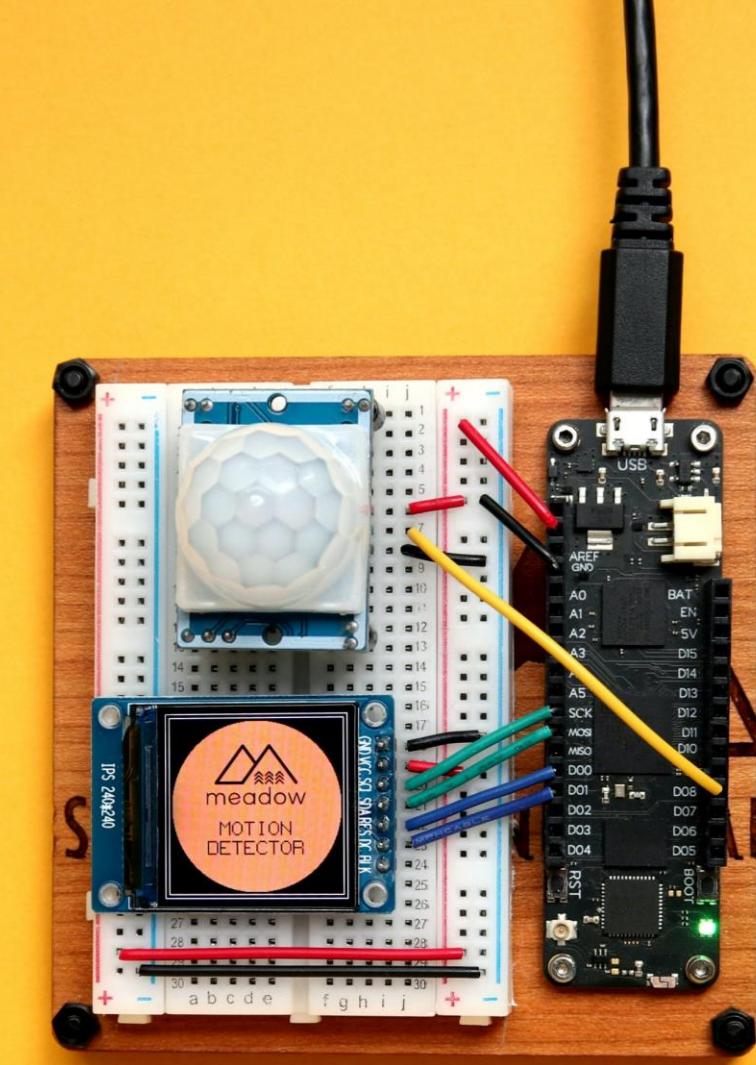
DO  
GOOD  
THINGS





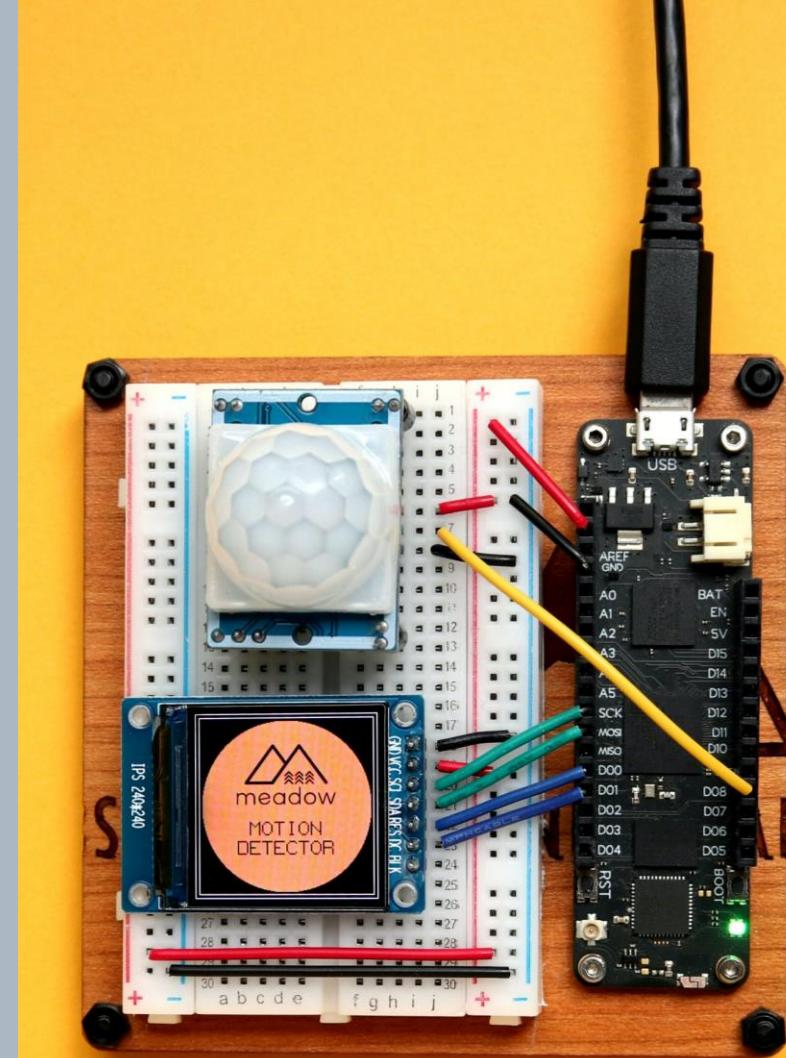


# Motion Sensors



# Motion Sensors

```
{  
  "motionDetected": true,  
  "batteryLevel": 90.5  
}
```



# Motion Sensors

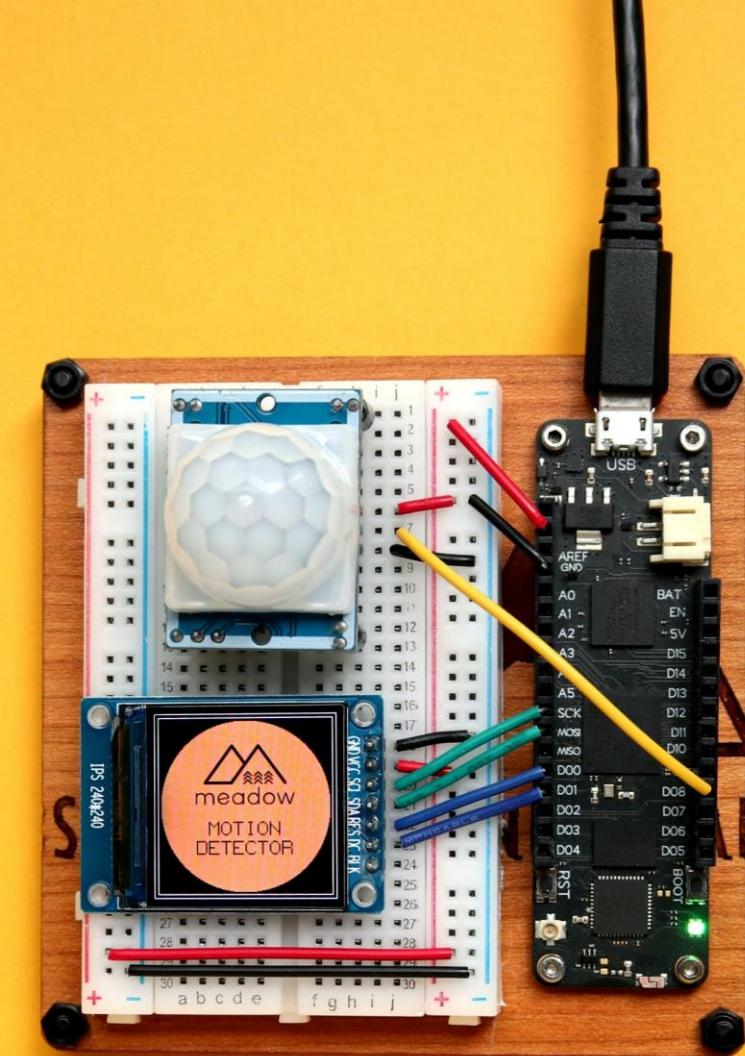
## Motion Sensor

### Properties:

- lastValue
- batteryLevel
- externalIds (map)

### Relationships:

- observes: Space



# Motion Sensors

## Motion Sensor

### Properties:

- lastValue
- batteryLevel
- externalIds (map)

### Relationships:

- observes: Space

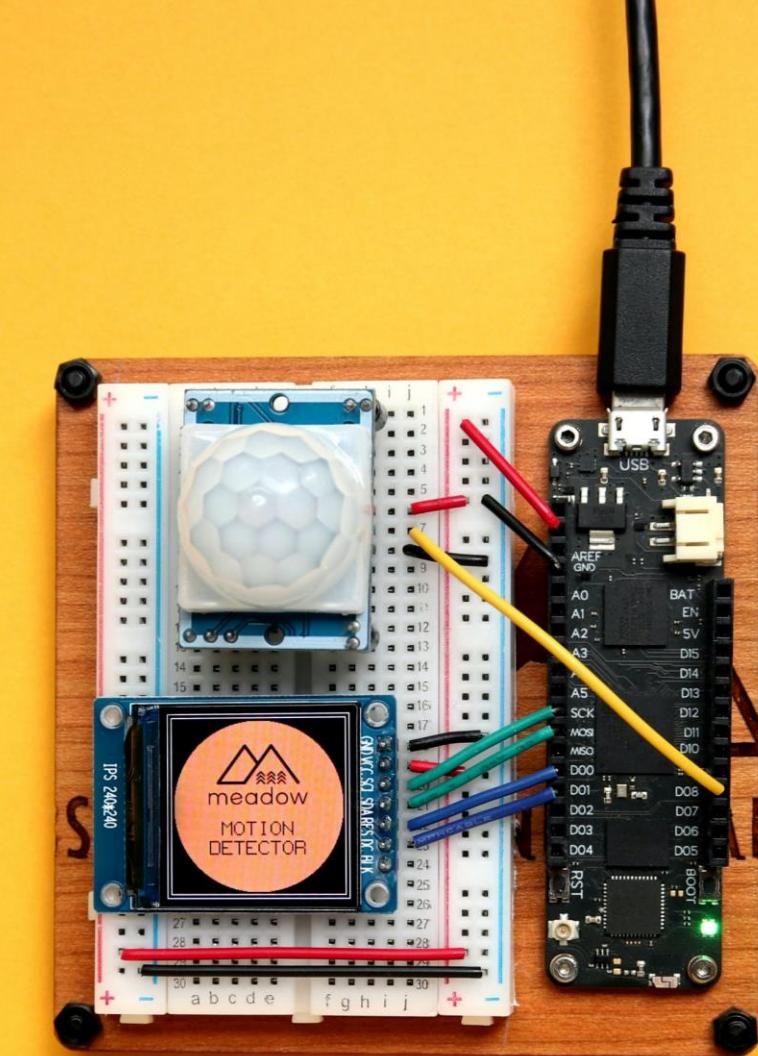
## Room

### Properties:

- name
- occupancy/isOccupied

### Relationships:

- isPartOf: Space

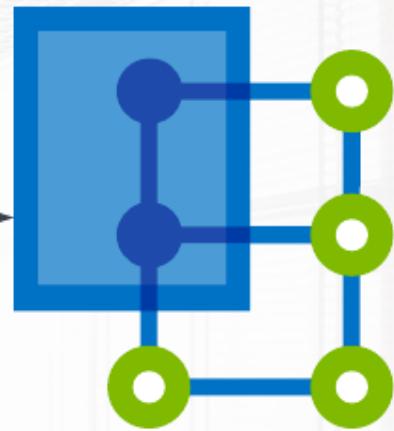




Azure IoT Hub



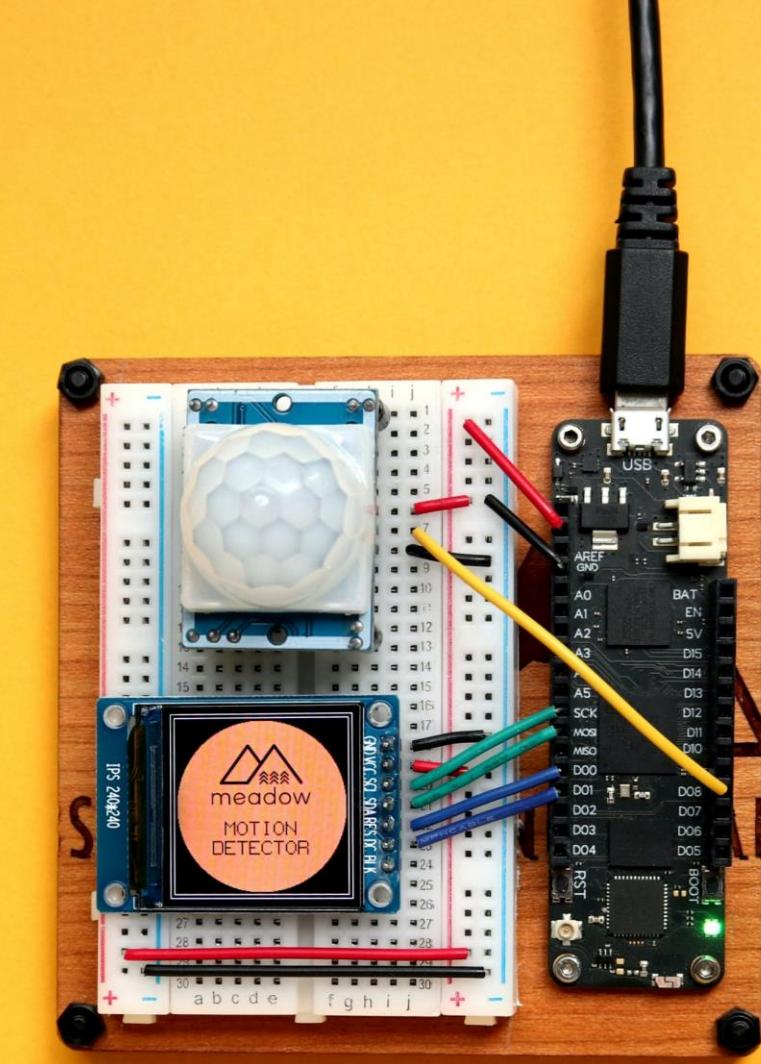
Message  
Handler



Azure Digital  
Twins

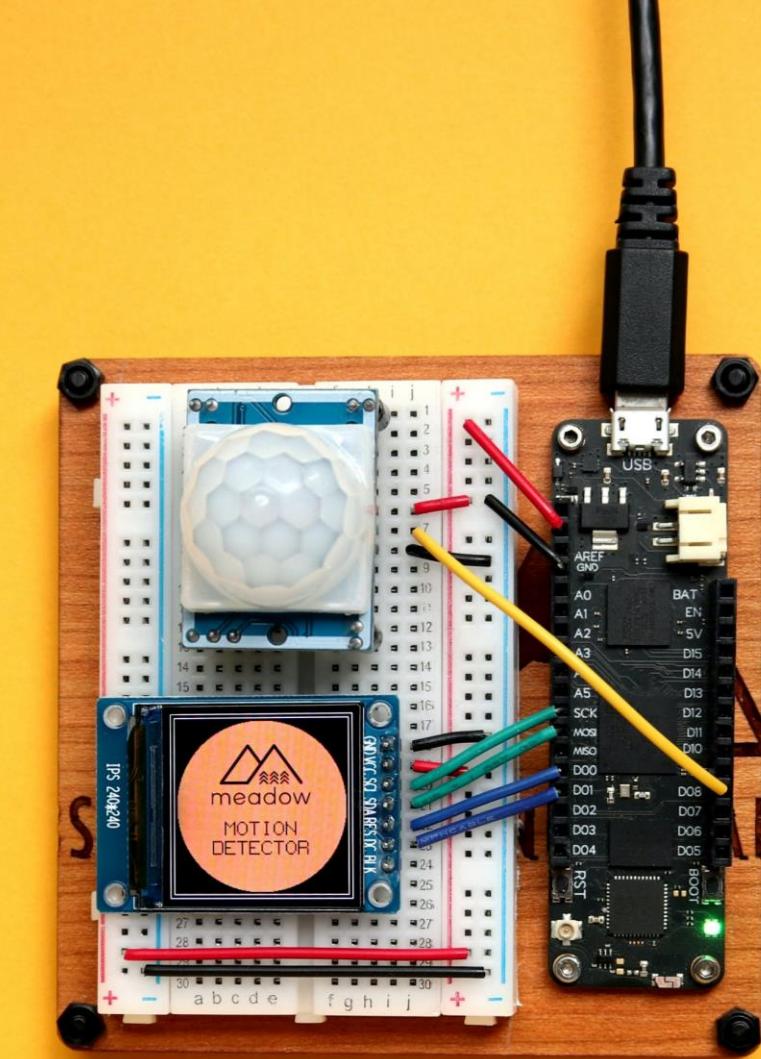
# Motion Sensors

Code!



# Motion Sensors

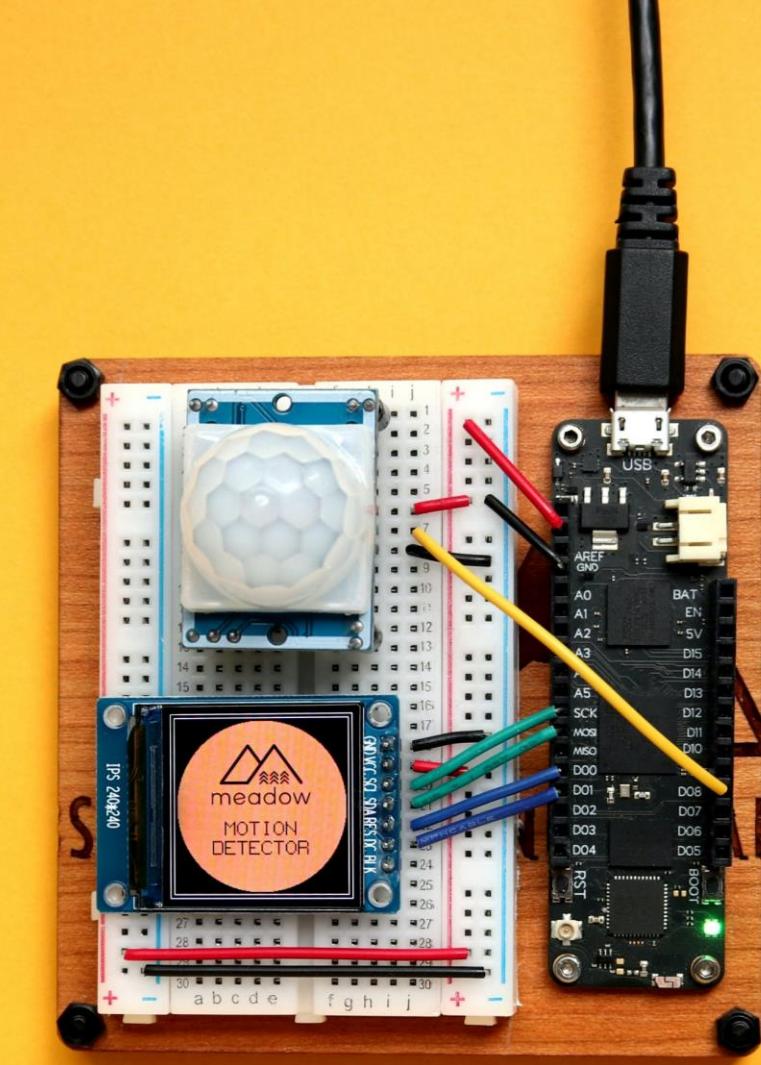
```
{  
  "motionDetected": true,  
  "batteryLevel": 90.5  
}
```



# Motion Sensors

```
{  
  "motionDetected": true,  
  "batteryLevel": 90.5  
}
```

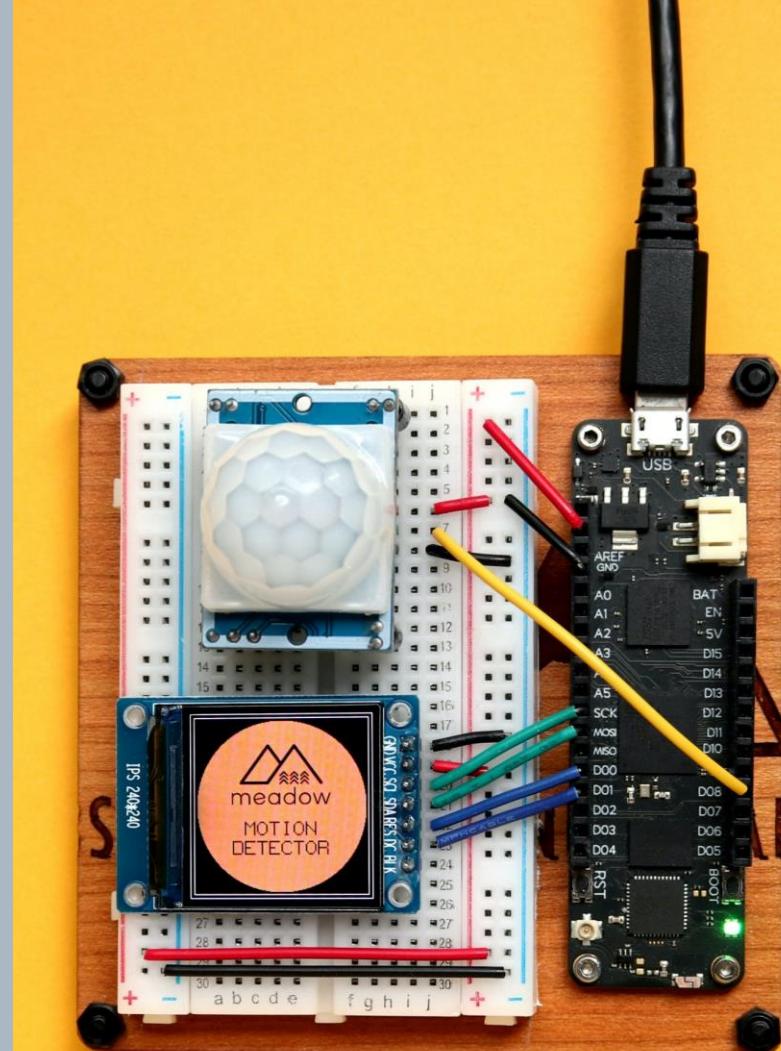
```
{  
  "motion": true,  
  "metadata": {  
    "levelOfBattery": 42  
  }  
}
```



# Motion Sensors

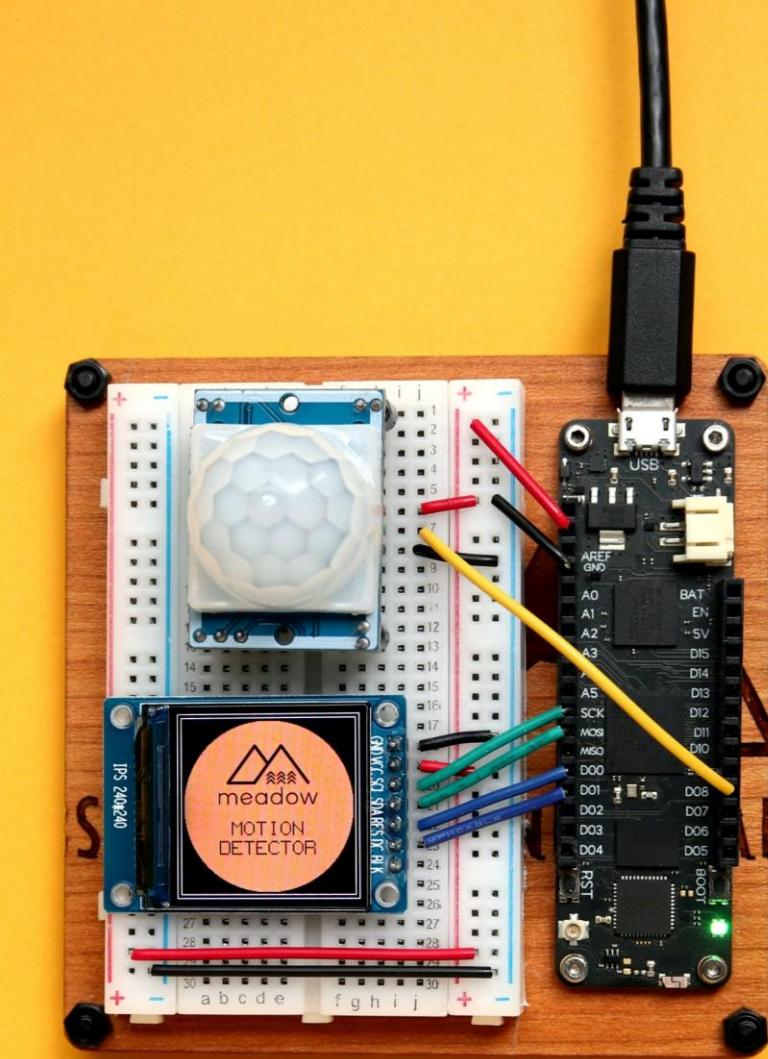
```
{  
  "type": "RoomBotXS",  
  "motionDetected": true,  
  "batteryLevel": 90.5  
}
```

```
{  
  "type": "DeskMotion2000",  
  "motion": true,  
  "metaData": {  
    "levelOfBattery": 42  
  }  
}
```



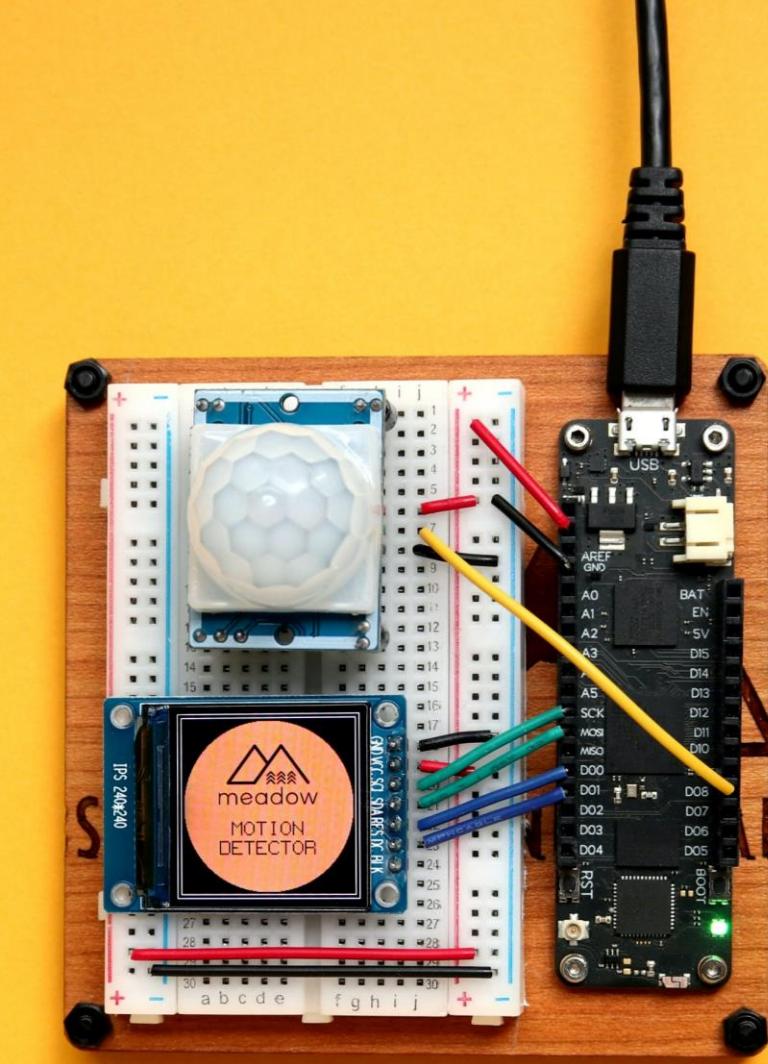
# Motion Sensors

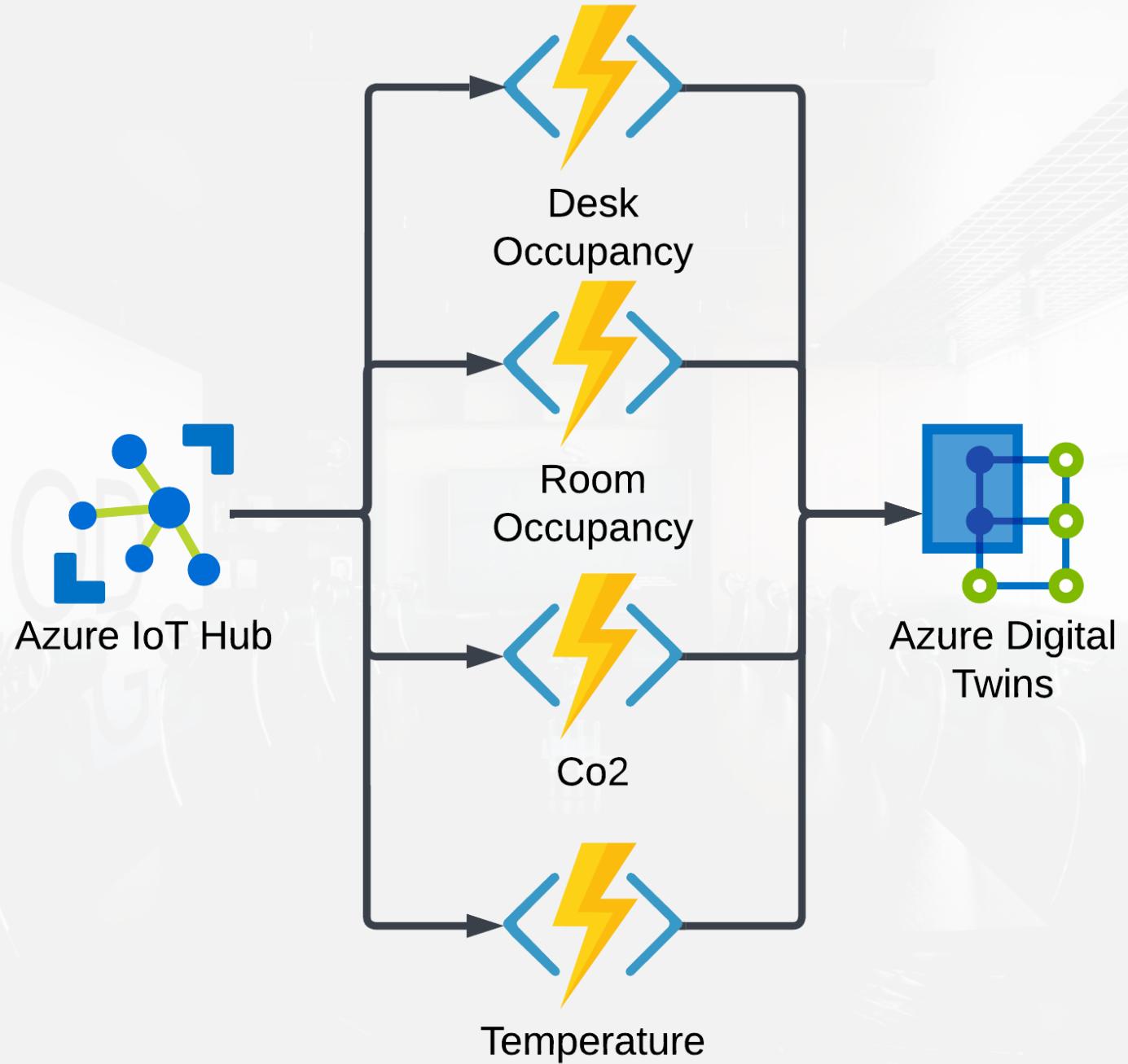
```
// The start of a great mess  
if(message.Type == "RoomBotXS") {  
    ...  
}  
else if(message.Type == "DeskMotion2000") {  
    ...  
}
```

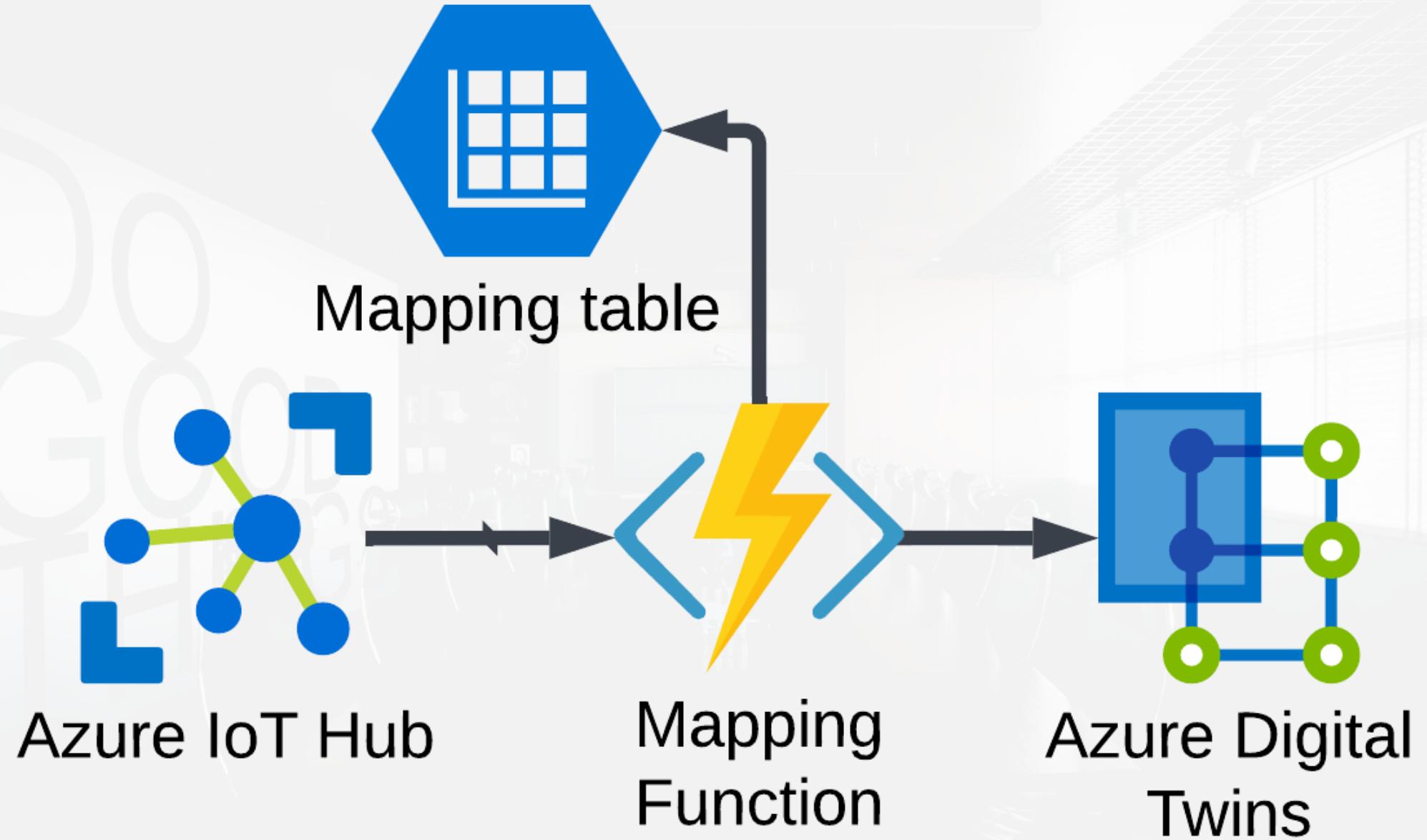


# Motion Sensors

```
// The start of a great mess  
  
if(message.Type == "RoomBotXS") {  
  
    ...  
}  
  
else if(message.Type == "DeskMotion2000") {  
  
    ...  
}  
  
else if(message.Type == "Co2 SniffMachine") {  
  
    // Please stop  
  
}
```

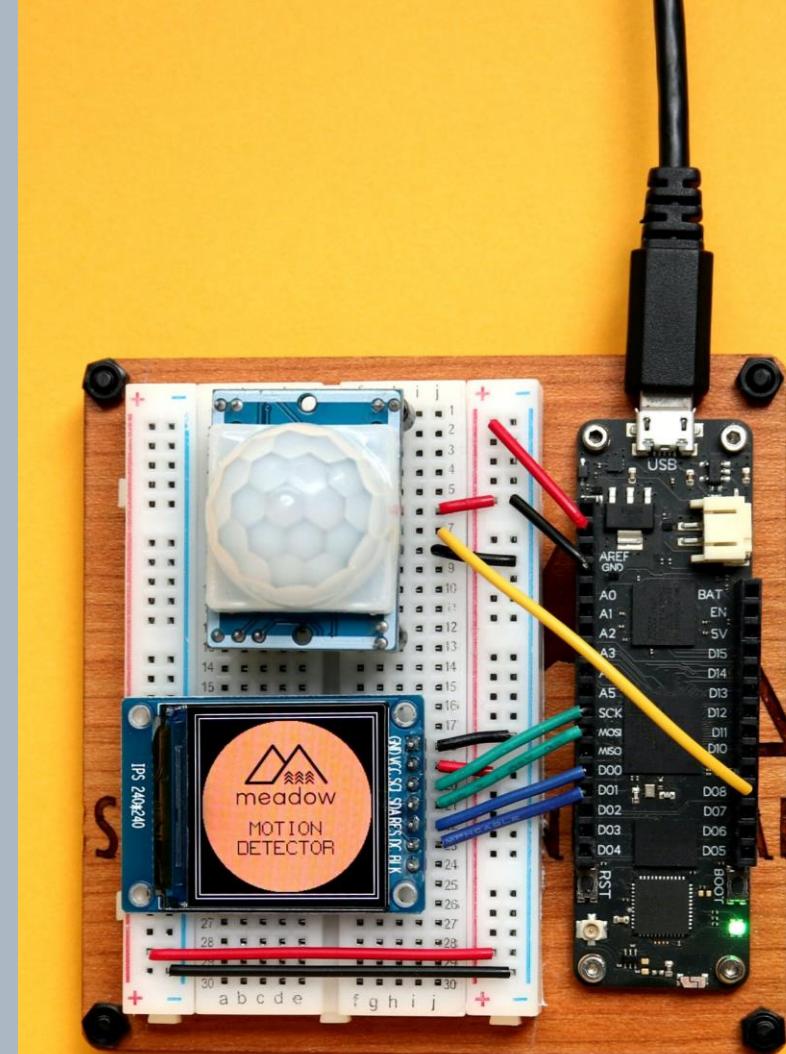






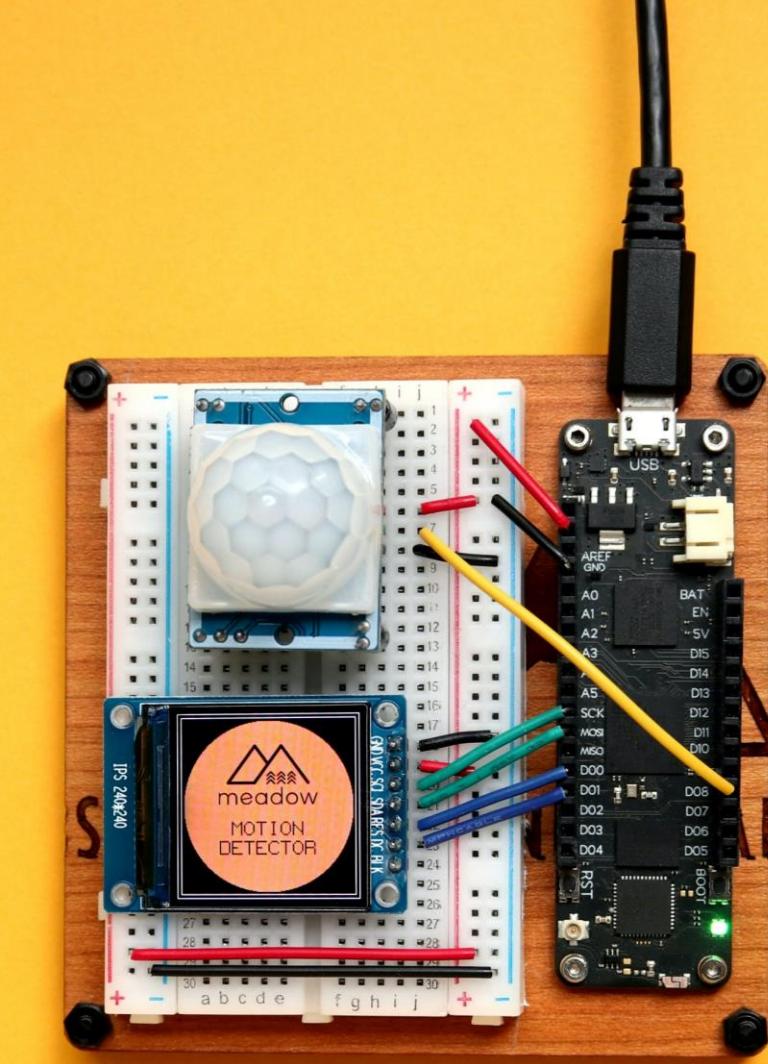
# Mapping

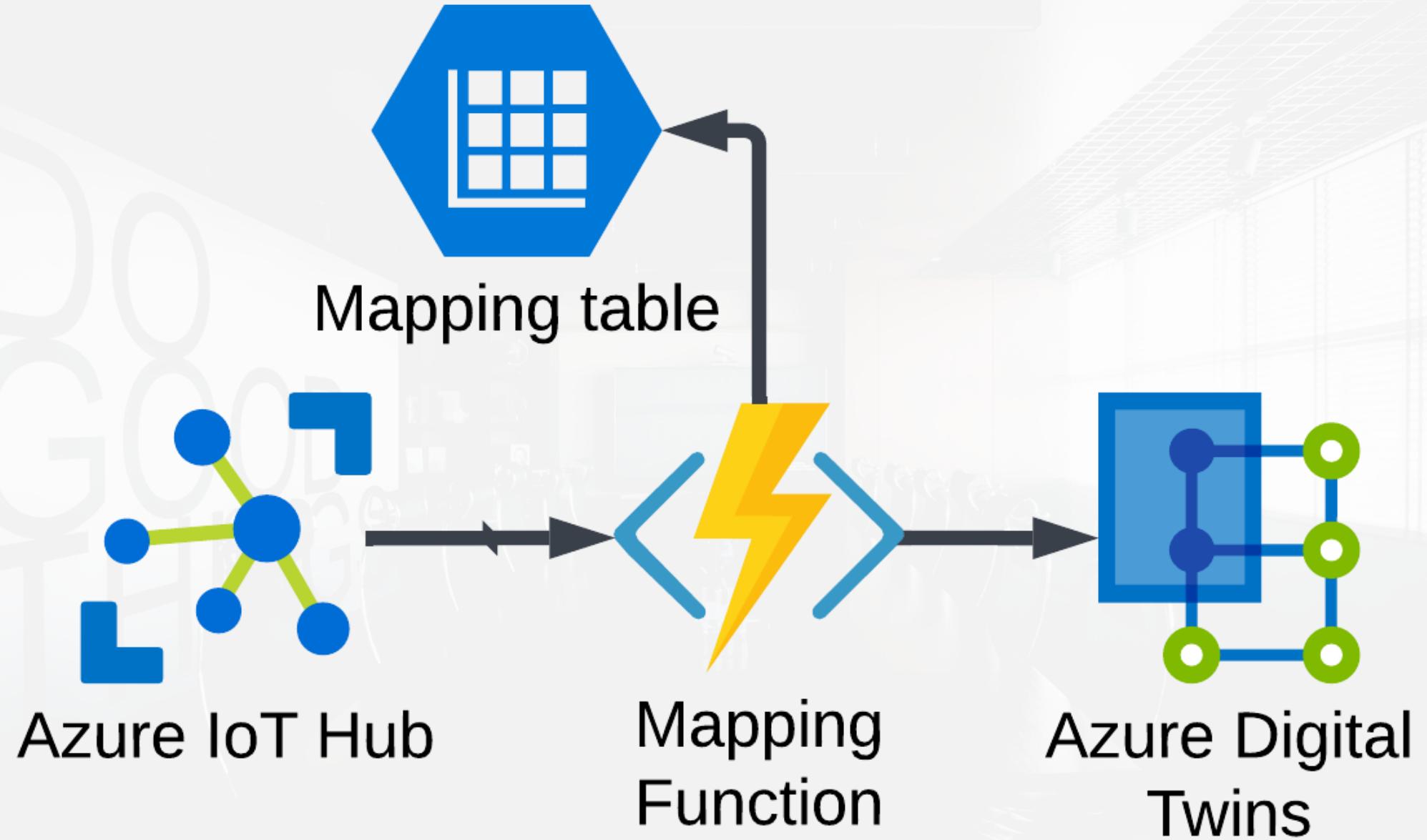
```
[  
 {  
     "Property": "Motion",  
     "DataType": "bool",  
     "TwinId": "088a7088-ef87-460c-9a7c-a696bdf6dbb4",  
     "TwinProperty": "/lastValue"  
 },  
 {  
     "Property": "Metadata/BatteryLevel",  
     "DataType": "double",  
     "TwinId": "088a7088-ef87-460c-9a7c-a696bdf6dbb4",  
     "TwinProperty": "/batteryLevel"  
 }  
 ]
```

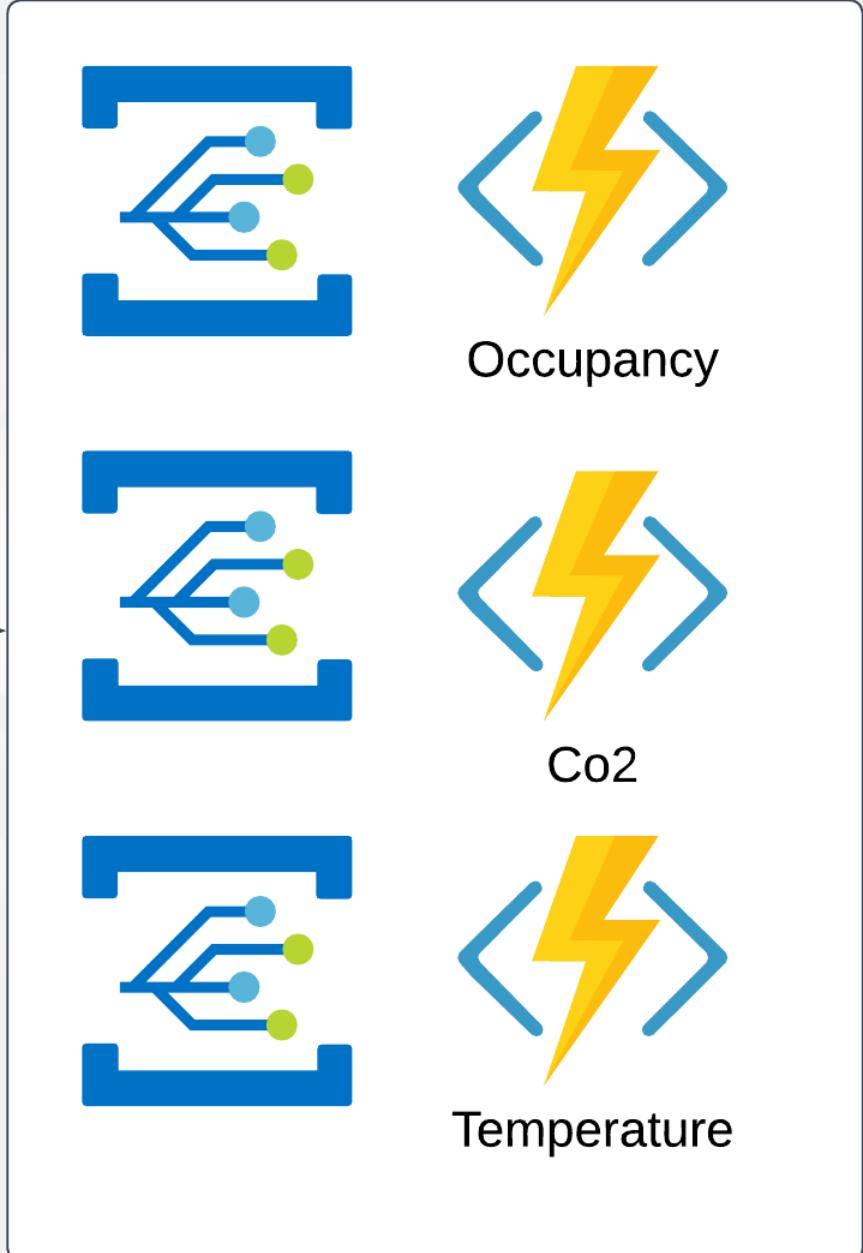
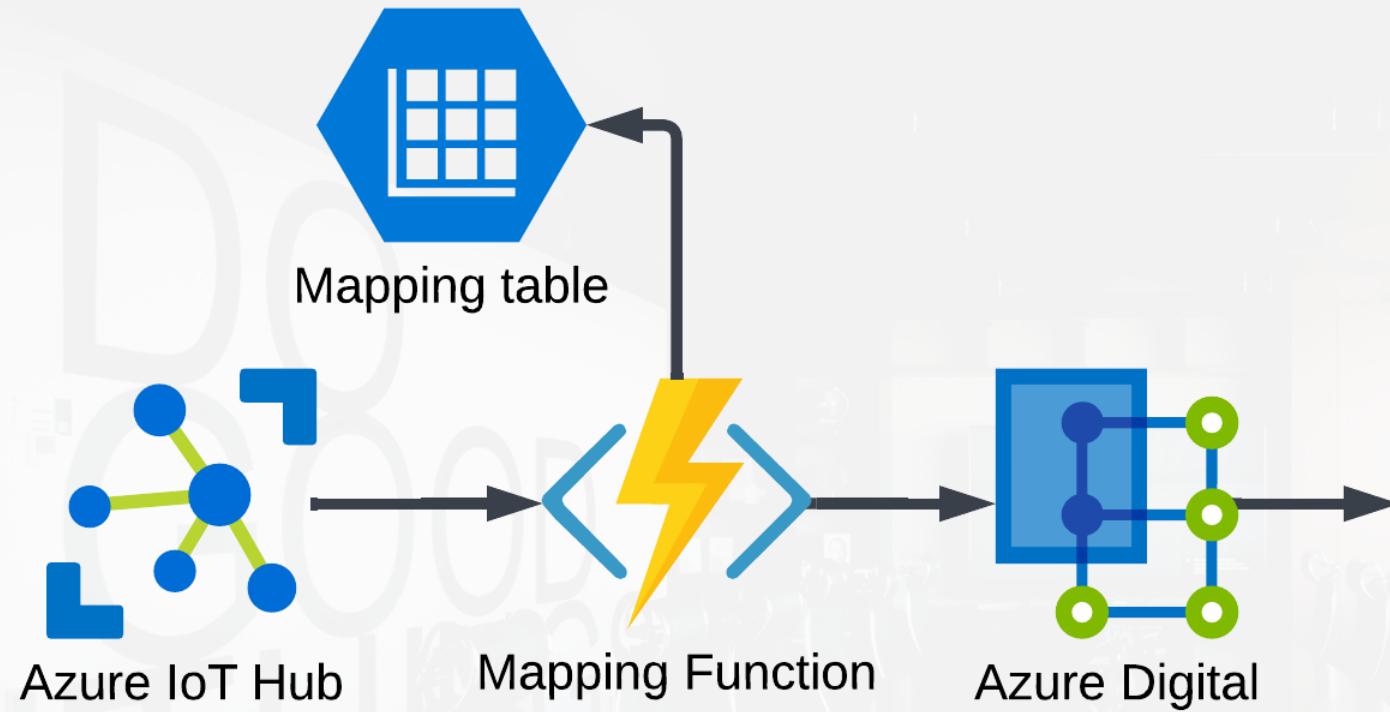


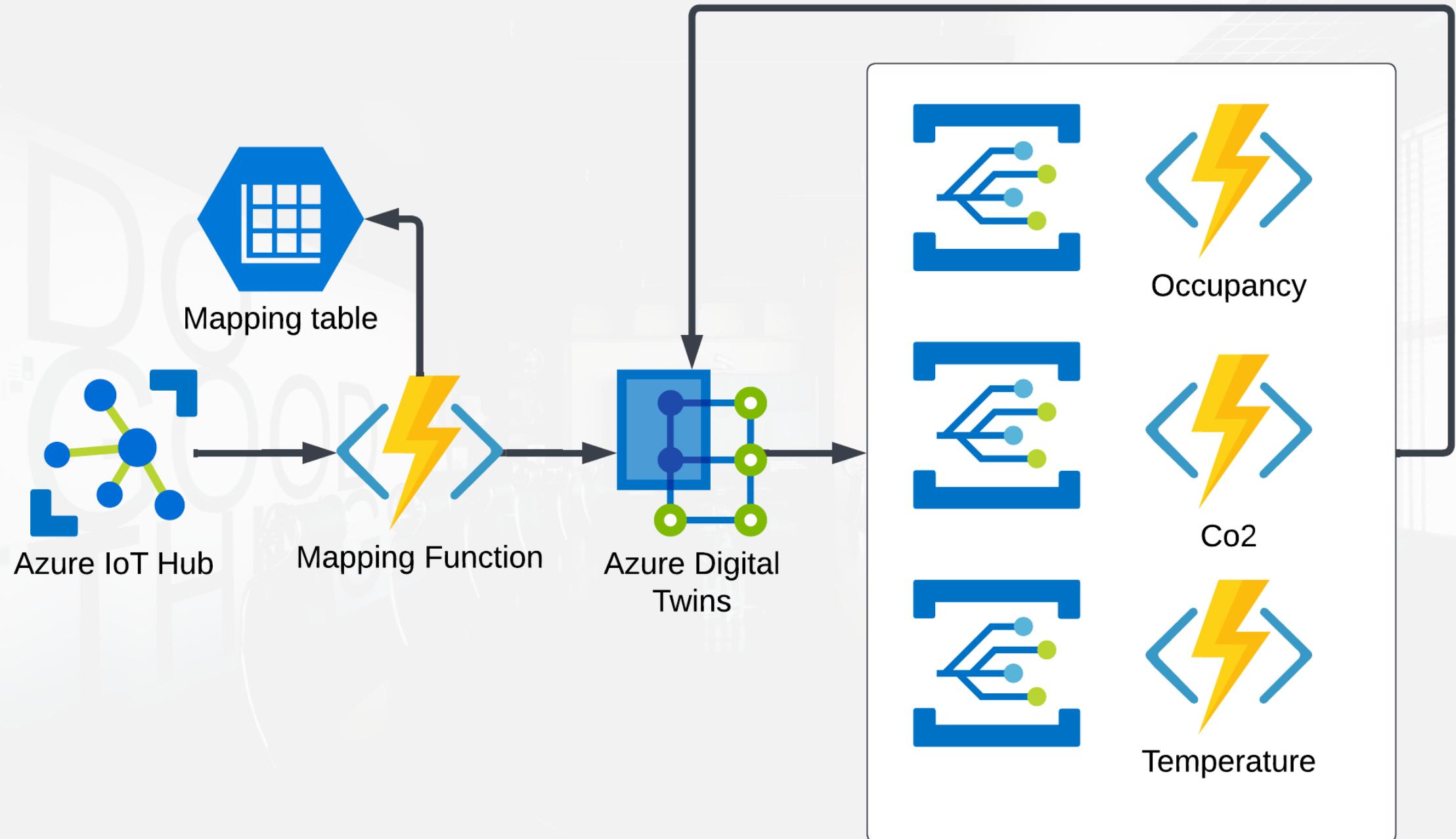
# Mapping

# Code!



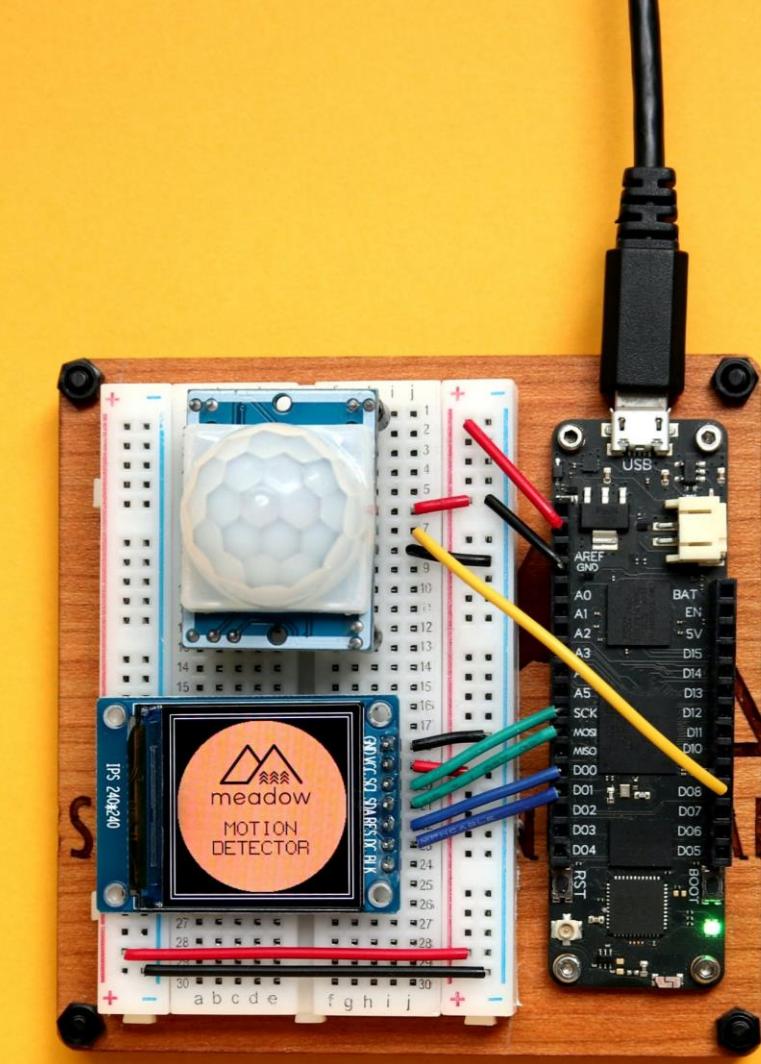


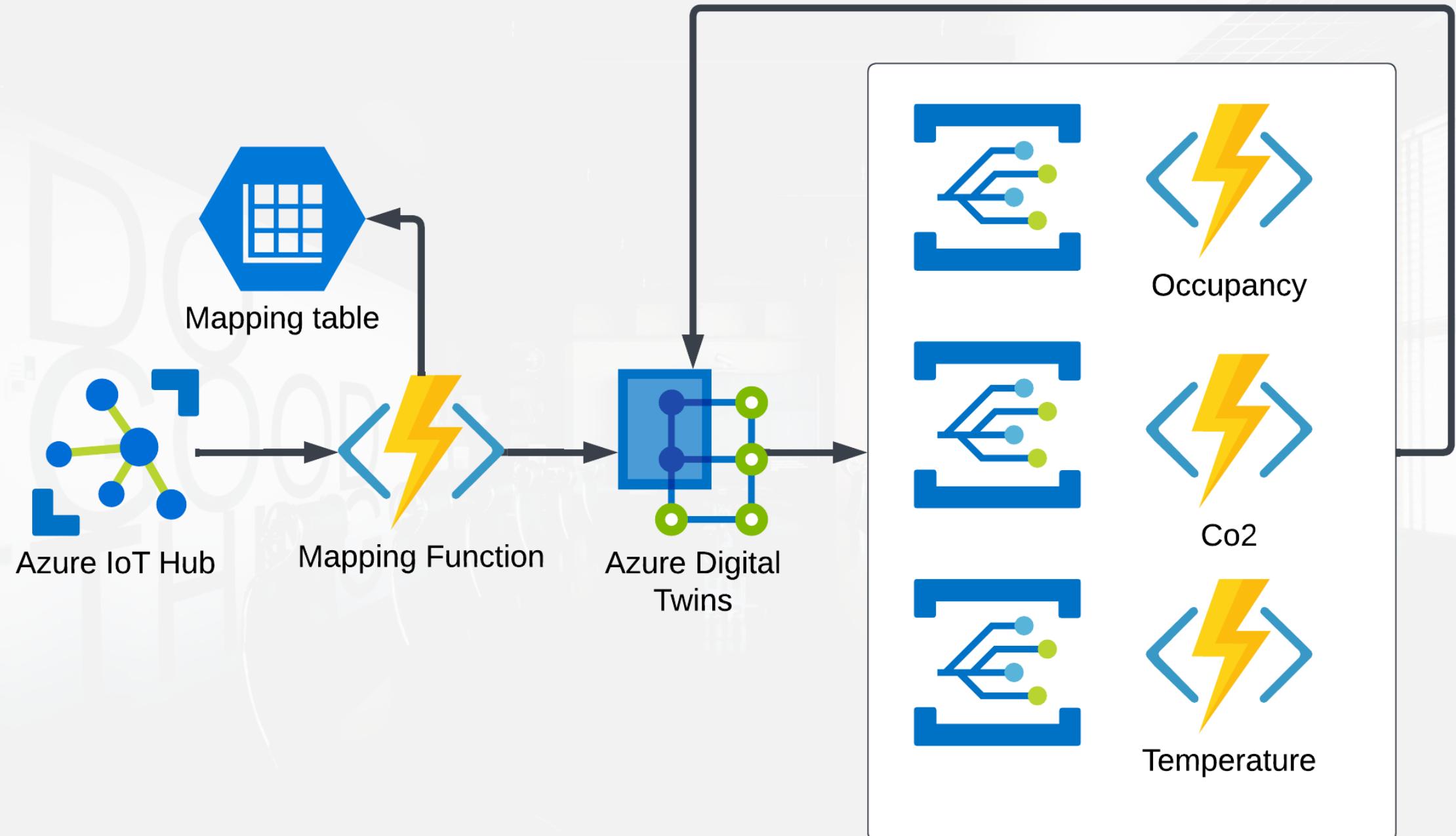


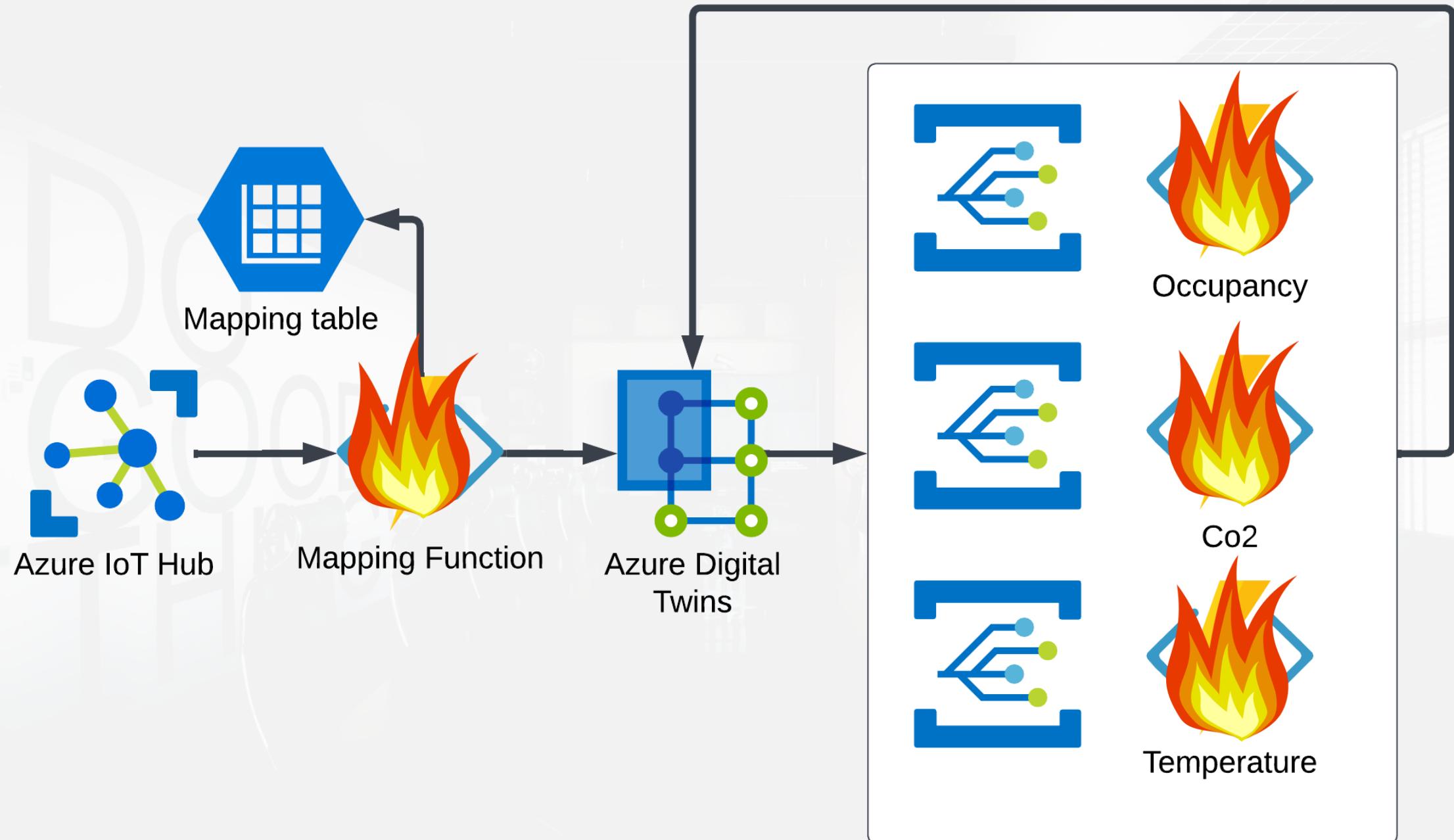


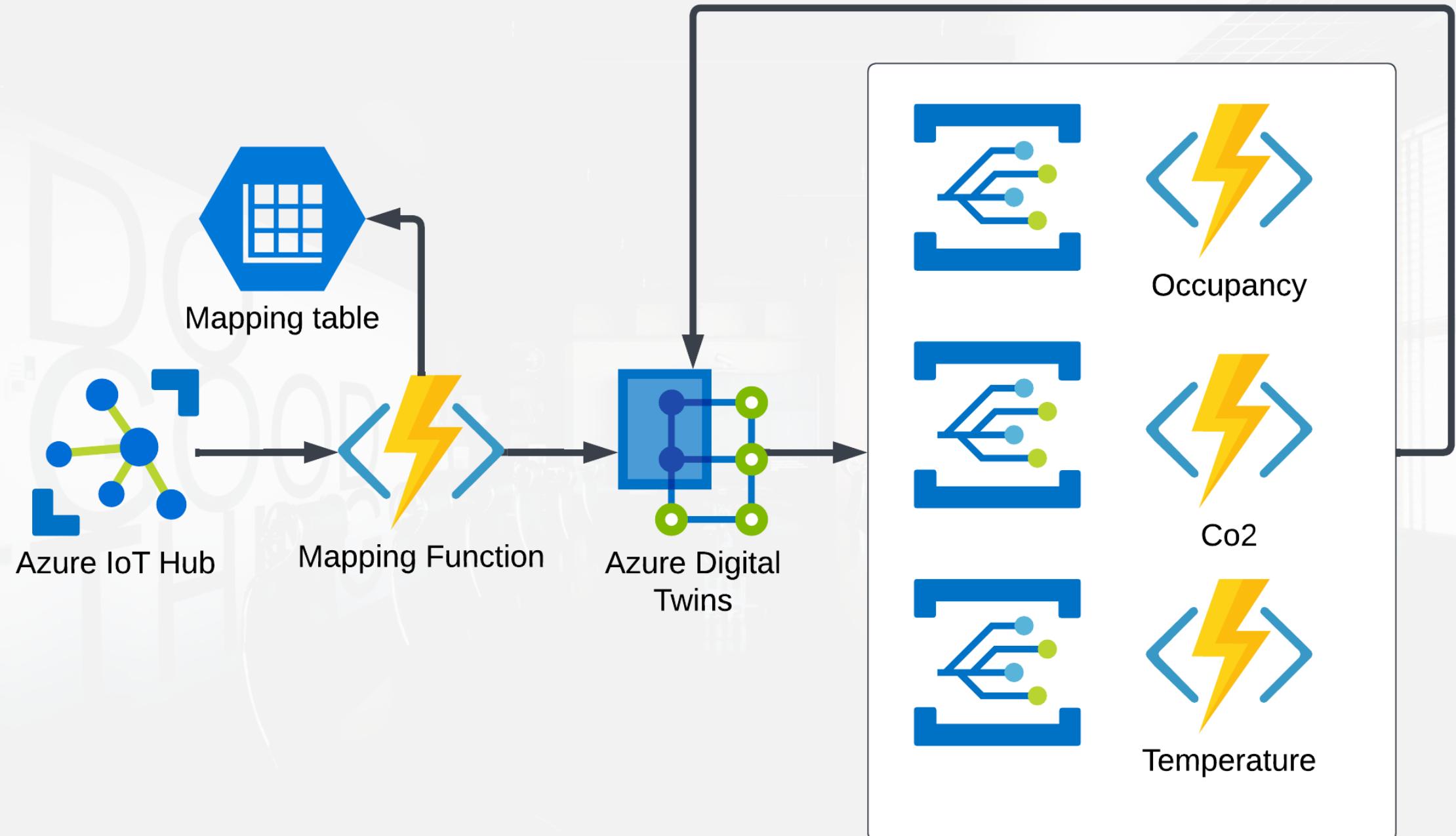
# Motion Sensors

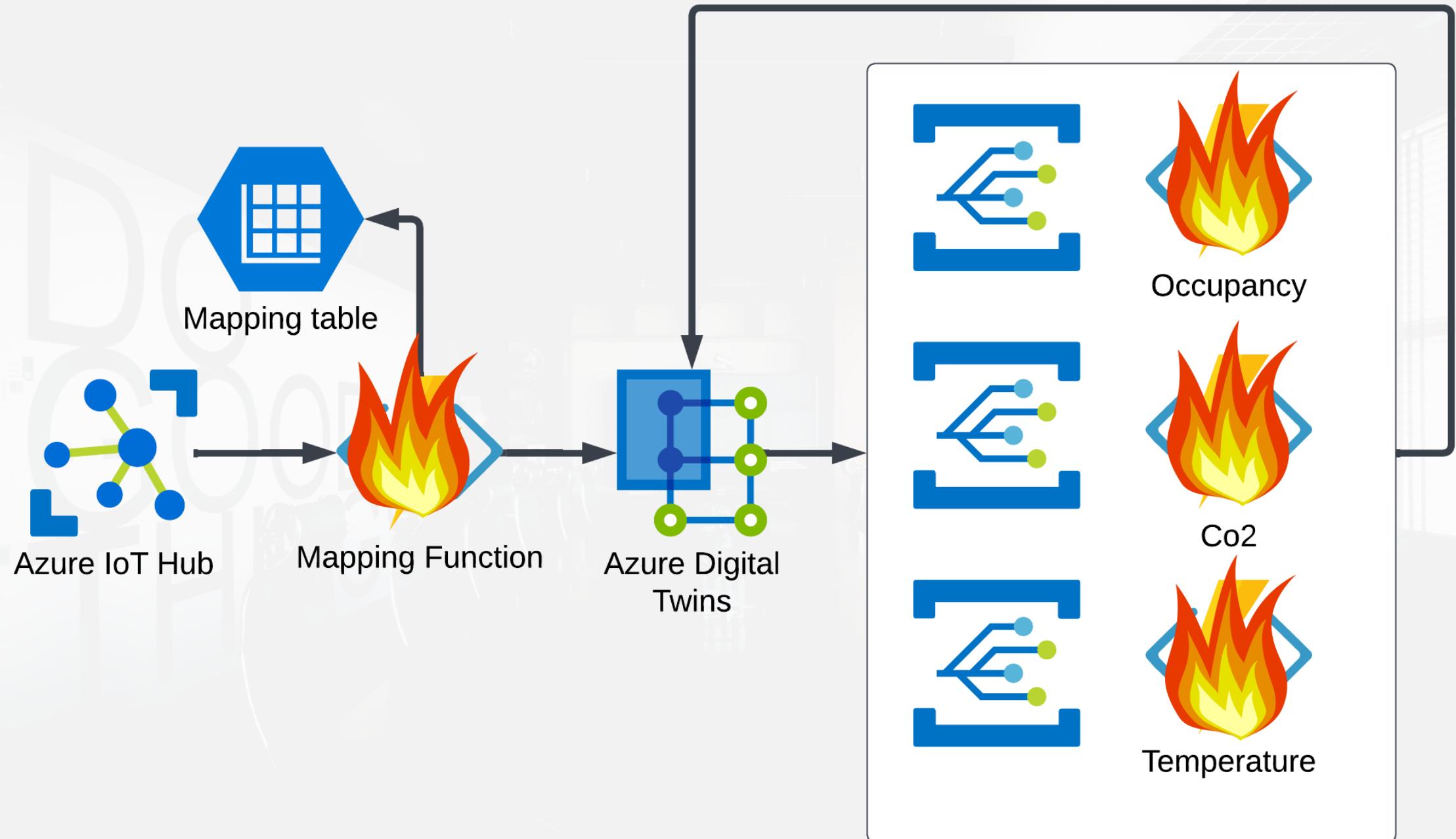
Code!

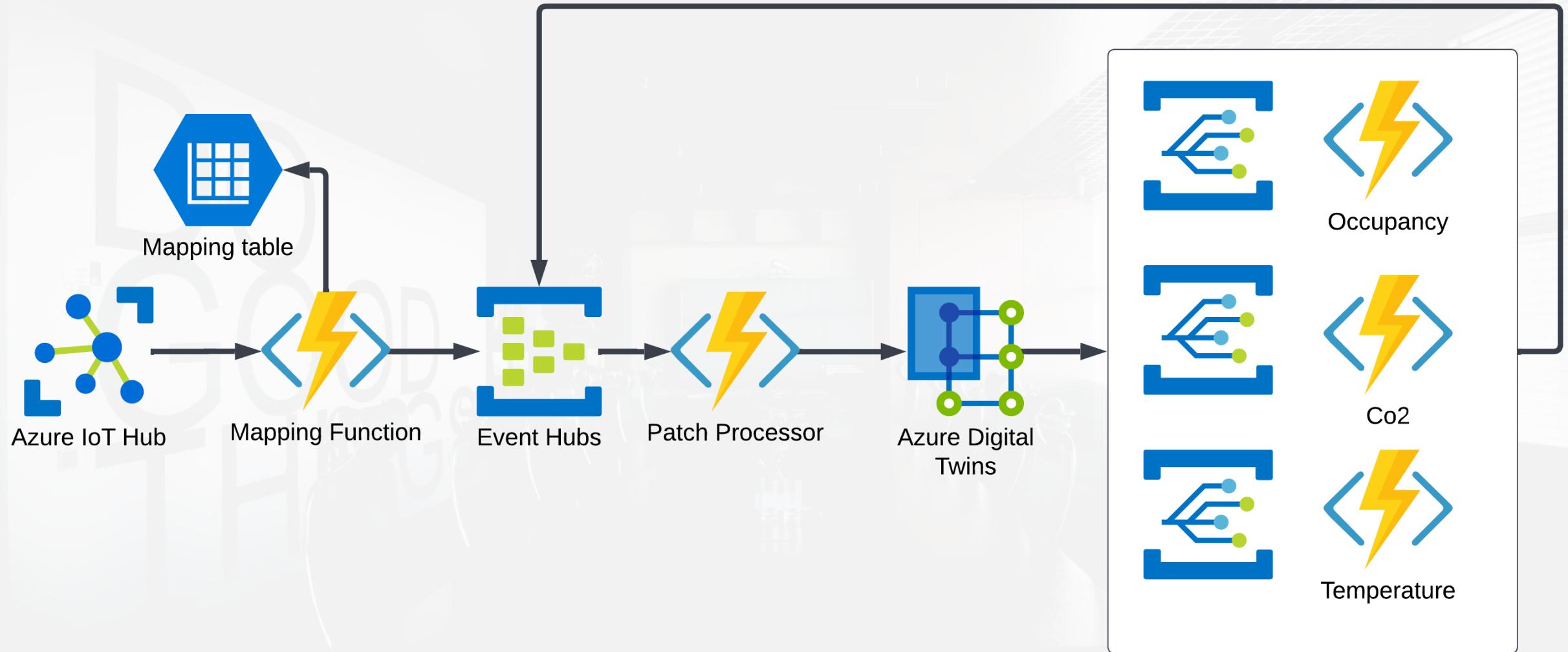


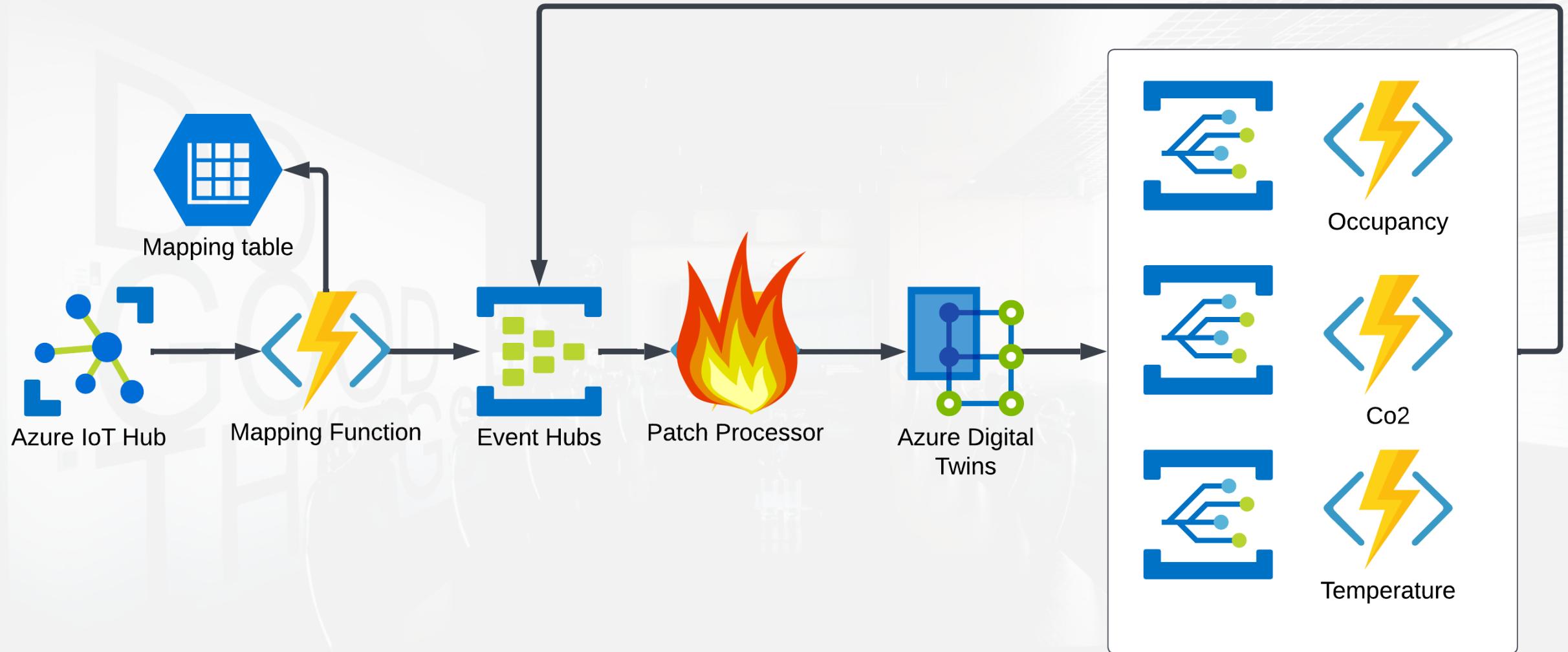


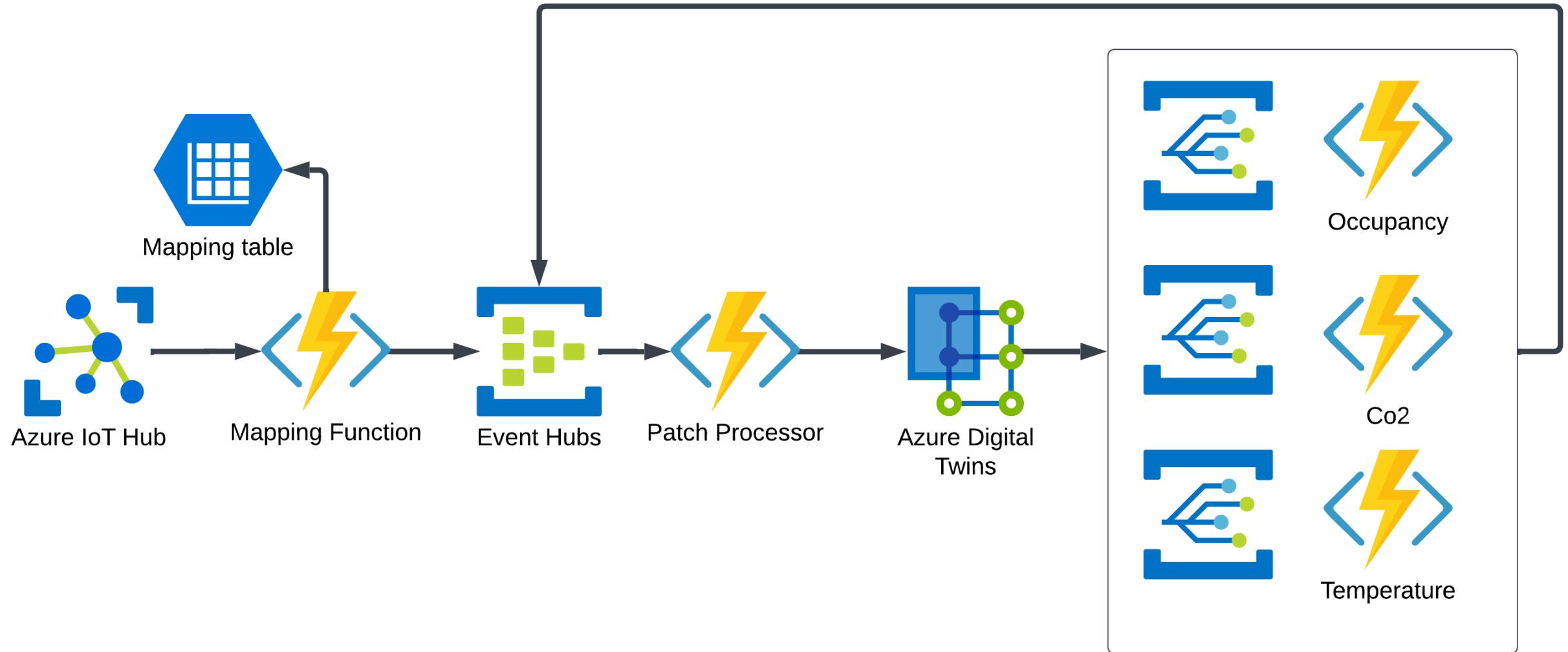


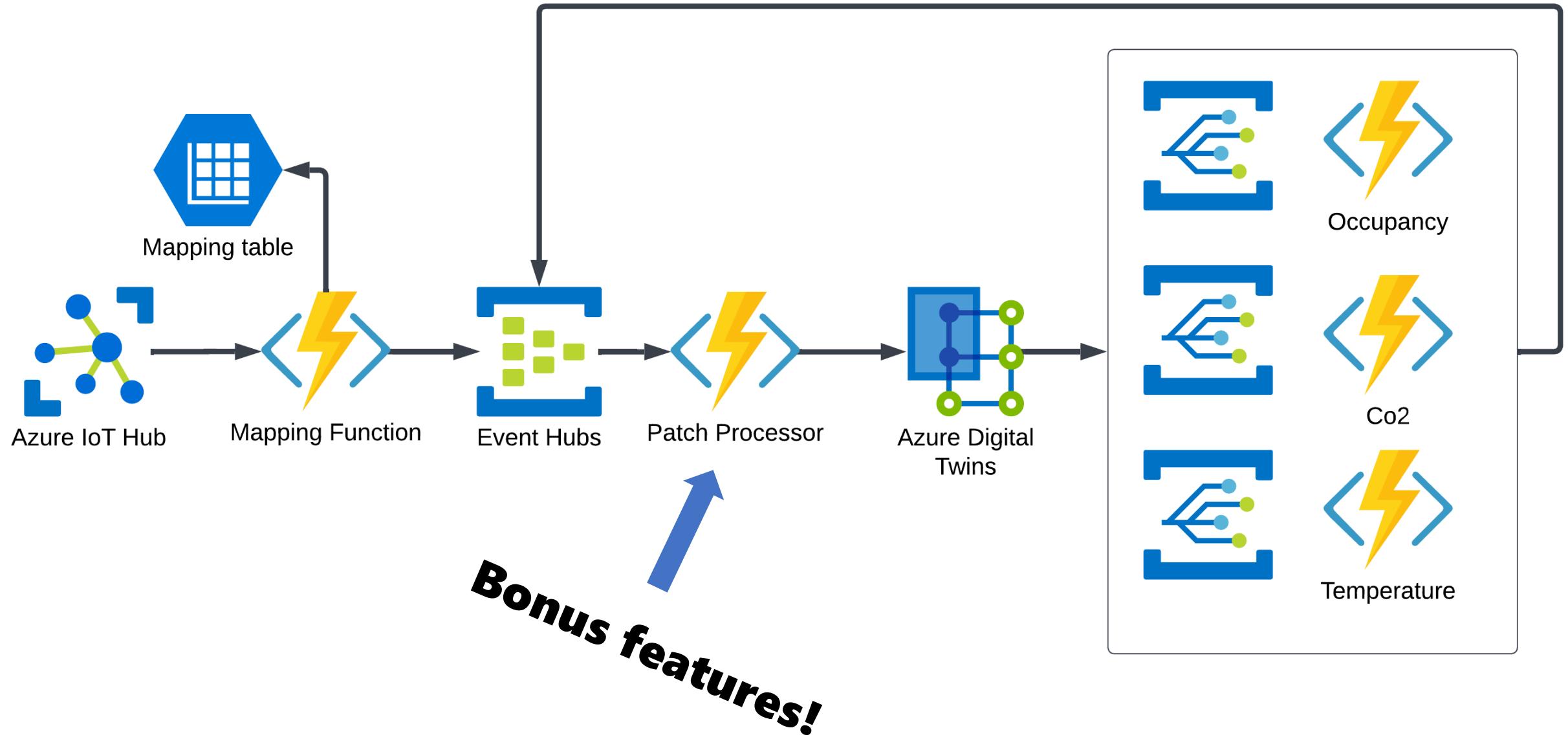






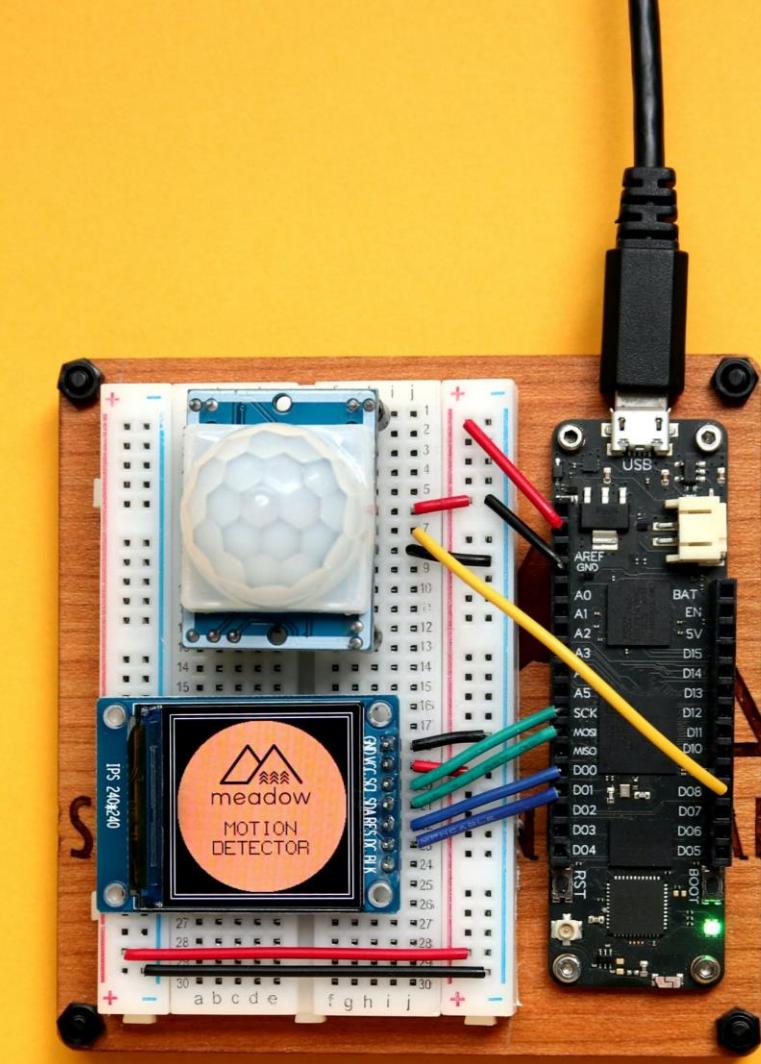






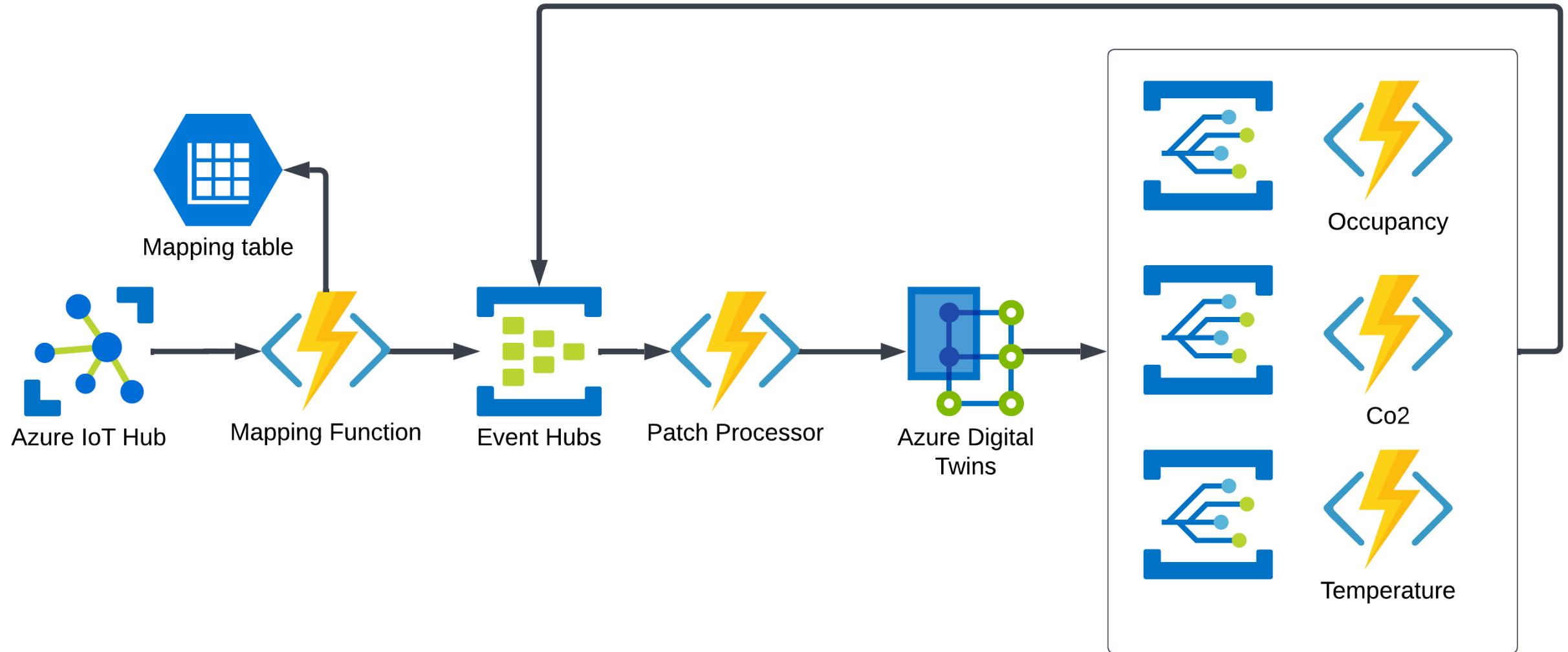
# Motion Sensors

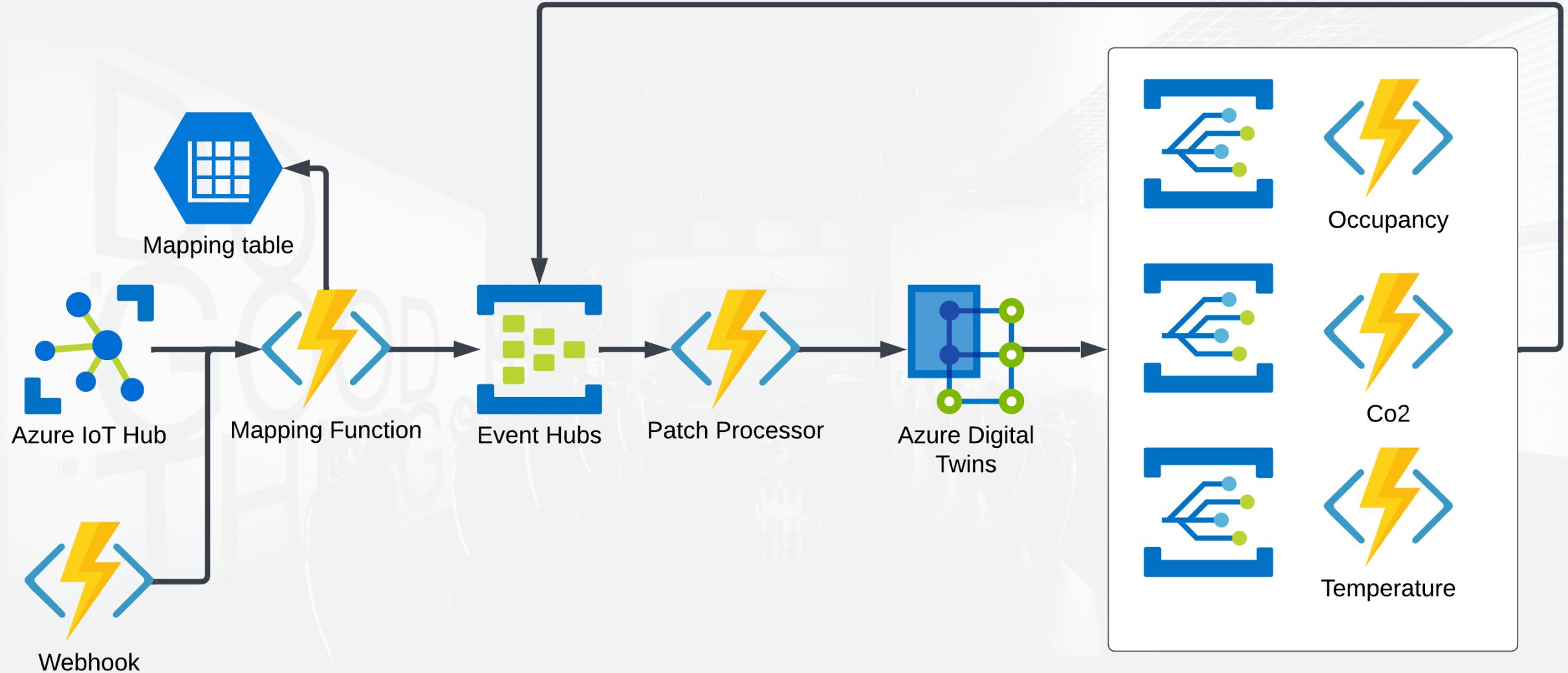
Code!



# A New Challenger Approaches







# Buildings & Weather



# Buildings & Weather

Building

Properties:

- Name
- Coordinates



# Buildings & Weather

## Building

### Properties:

- Name
- Coordinates

## Weather

### Properties:

- Condition
- Temperature

### Relationship:

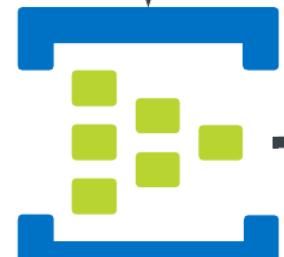
- isCapabilityOf: building



# API

Weather API

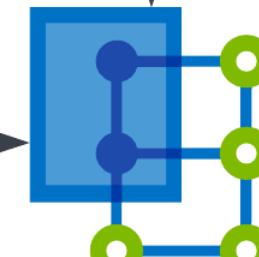
Weather Provider



Event Hubs



Patch Processor



Azure Digital  
Twins

# Buildings & Weather

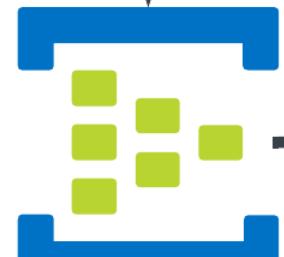
Code!



# API

Weather API

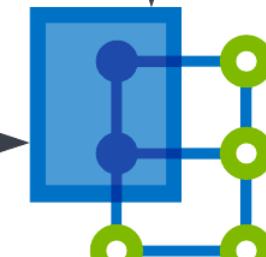
Weather Provider



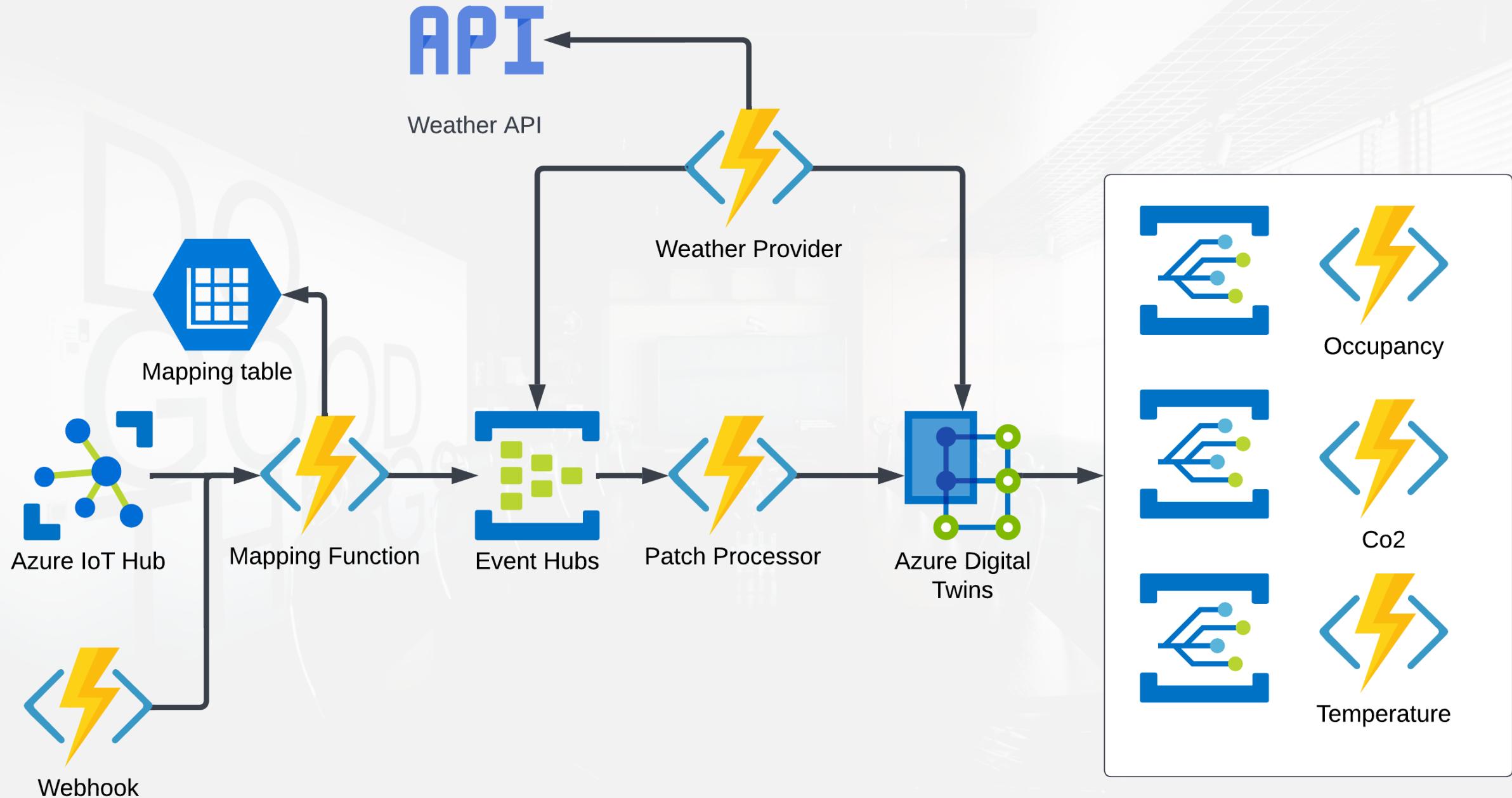
Event Hubs

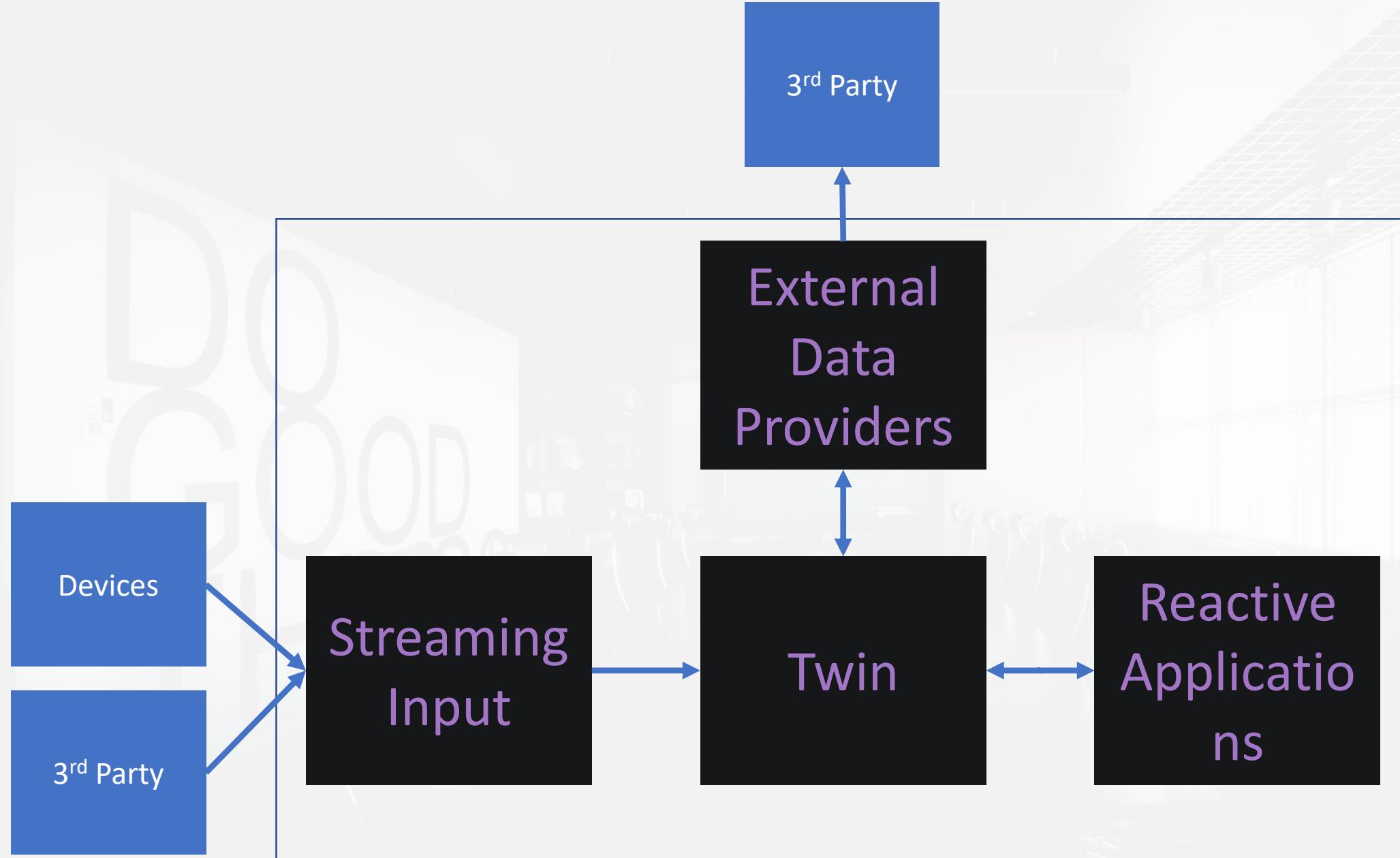


Patch Processor



Azure Digital  
Twins

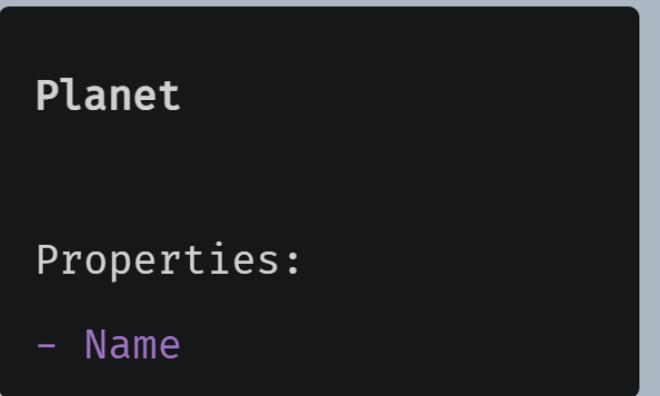




A nighttime satellite view of Earth from space, showing city lights and auroras.

Copy. The. World.

# Copy The World



# Copy The World

Planet

Properties:

- Name

Country

Properties:

- Name

Relationships:

- LocatedOn: Planet





## QUERY EXPLORER

Saved Queries

SELECT \* FROM digitaltwins WHERE \$dtId = 'earth'

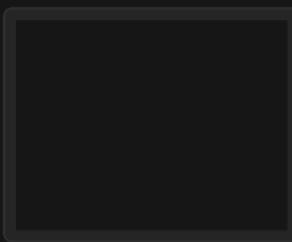
Overlay results 

Run Query



## TWIN GRAPH

## MODEL GRAPH

 name                



QUERY EXPLORER

## Saved Queries

```
SELECT * FROM digitaltwins WHERE $dtId = 'earth'
```

Overlay results

Run Query



#### TWIN GRAPH

---

Digitized by srujanika@gmail.com

 name 





## QUERY EXPLORER

Saved Queries

SELECT T FROM DIGITALTWINS T WHERE T.\$dtId = 'netherlands'

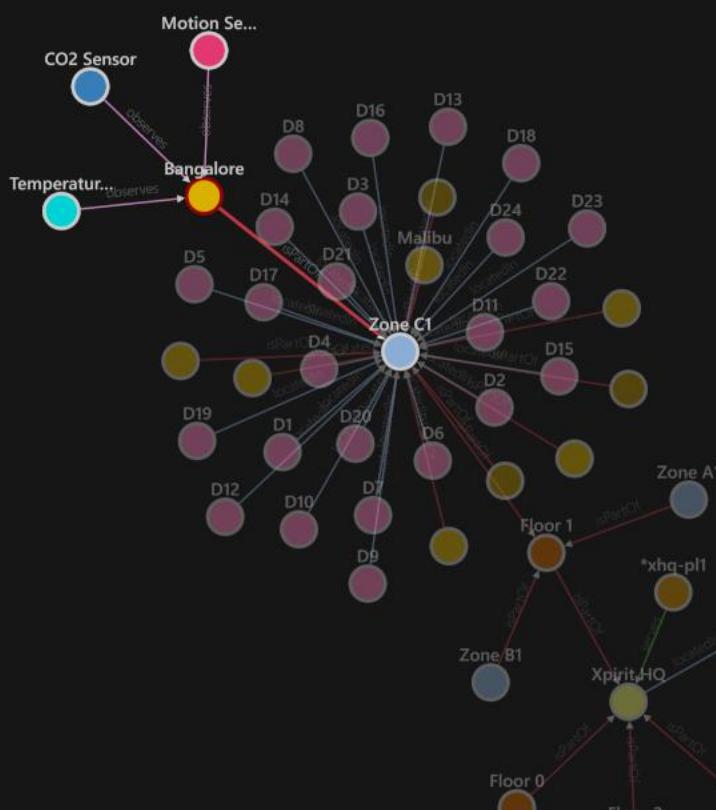
Overlay results 

Run Query

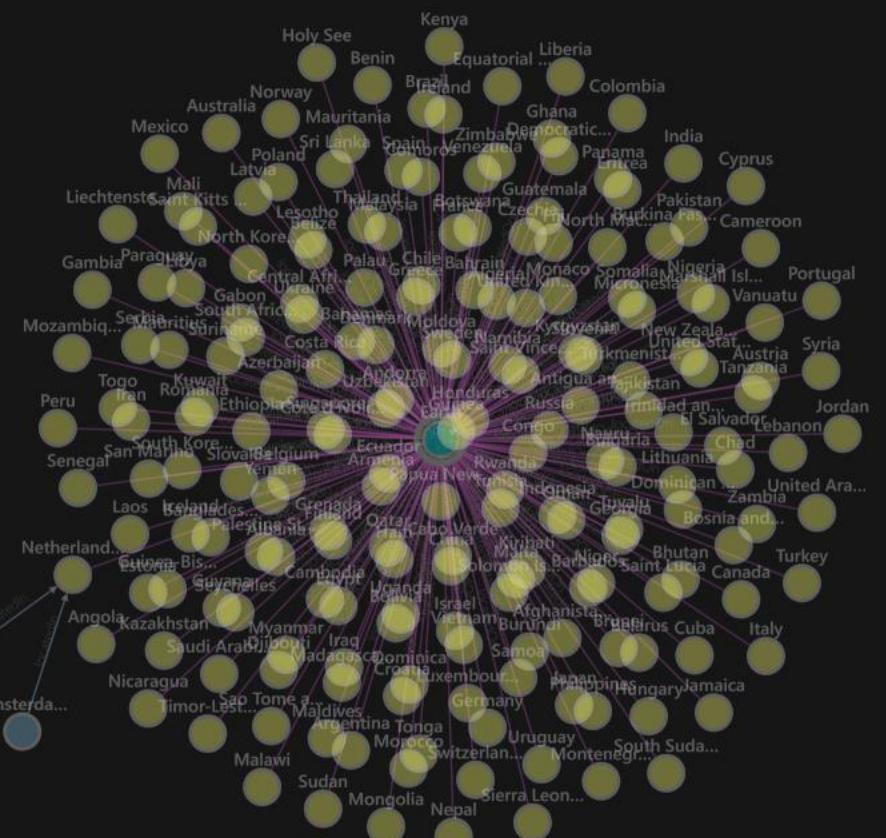


## TWIN GRAPH

## MODEL GRAPH



name



# An unoccupied Office. Anywhere on Earth.

```
SELECT rooms FROM DIGITALTWINS  
  
MATCH (planets)←[:isPartOf|locatedIn|locatedOn*4 .. 6]-(rooms)  
  
WHERE planets.$dtId = 'earth'  
  
AND IS_OF_MODEL(rooms, 'dtmi:digitaltwins:rec_3_3:core:Room;1')  
  
AND rooms.CO2.CO2Sensor < 800  
  
AND rooms.occupancy.isOccupied = false
```



404

A nighttime view of Earth from space, showing city lights and the aurora borealis.

Q&A

Matthijs van der Veer **THANK YOU!**  
Xpirit Netherlands  
@matthijsvdveer <https://vanderveer.io>  
<https://github.com/MatthijsvdVeer/copy-the-world>

Attributions

DALL-E, pictures

Unsplash.com, pictures used for backgrounds

giphy.com for animated gifs

