# IoT Levels of Deployment:

$\hookrightarrow$ Based on the numbering of monitoring nodes used, type of database used, complexity/simplicity of computational analysis, there are Six (6) levels of IoT are incorporated.

$\hookrightarrow$ Different applications are developed based on this level.

$\hookrightarrow$ The IoT Systems consist of the following components.

$\rightarrow$ <u>Device:</u> are the physical entities equipped with Sensors, actuators and connectivity that interact with the environment and collect data, which are the basic building blocks of IoT responsible for data generation and communication.

Ex: smart home devices: Like smart thermostats and lighting.

$\rightarrow$ <u>Resources:</u> Refers to the computing capabilities and storage available in the IoT eco System. These resources may reside on devices or cloud Servers and are utilized for data processing analysis and Storage.

Ex: Communication N/ws: Wi-Fi, cellular networks, Bluetooth, Zigbee and Z-wave, satellite communication,

Ex: Data processing and storage: cloud platforms, Edge Computing, Local Databases, Data analytics.

Ex: cloud platforms: AWS (Amazon Web Services), Google cloud and Azure provides Storage, processing power and networking Infrastructure.

$\rightarrow$ <u>Controller Services:</u> Manages the overall operations of the IoT, it handles the tasks such as devices coordination, data flow management and communication between devices and the central System. It acts as the brains by receiving data from Sensors, processing it, and then sending commands to actuators to control devices.

Ex: The controller Services are implemented as softwares running on device, on a central server in the cloud, or even on edge devices for faster response times.

→ **Database:** used to manage the vast amounts of data generated by IoT devices.

Ex: RDBMS (Relational Data base management System)

→ **Web service:** It provides the communication and interaction between devices and applications over the internet. They enable data exchange and provide APIs for integration with other Systems.
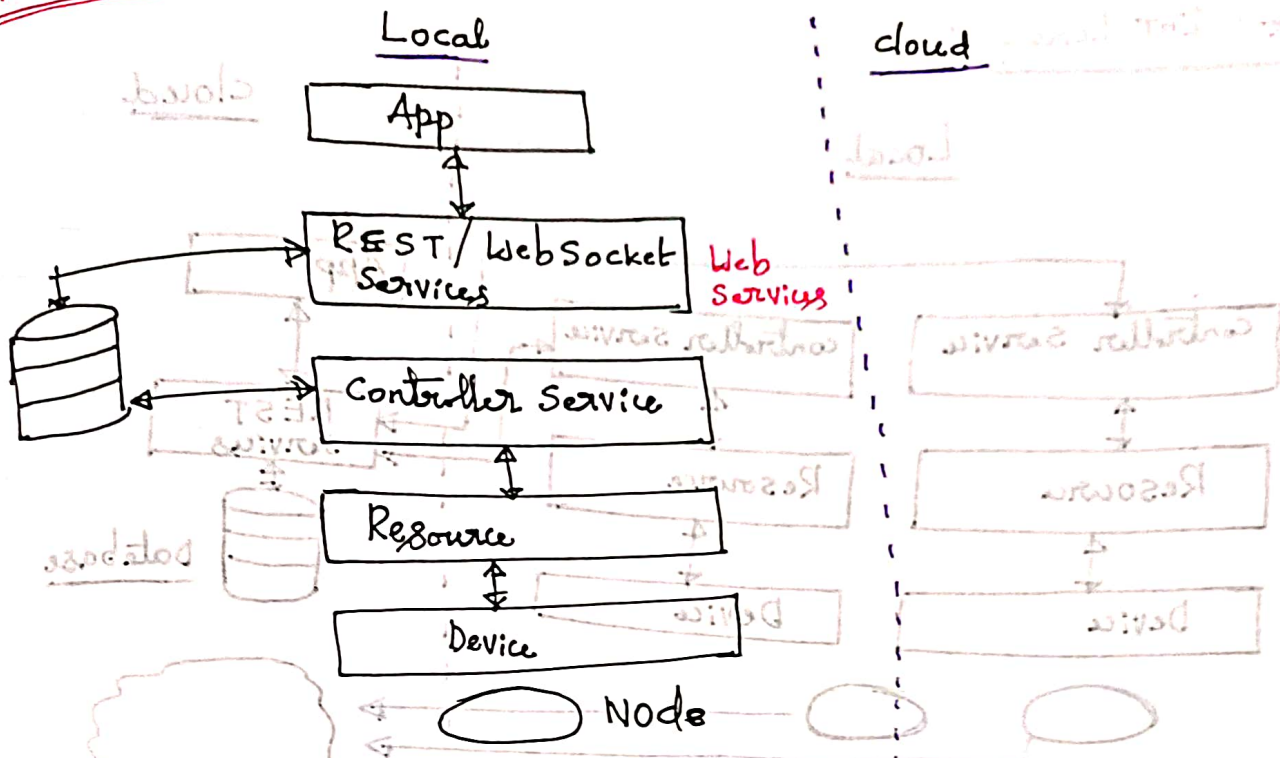
Ex: REST API (Representational state Transfer), MQTT (Message Queuing Telemetry Transport).

→ **Analysis component:** Responsible for processing and analyzing the data collected from devices

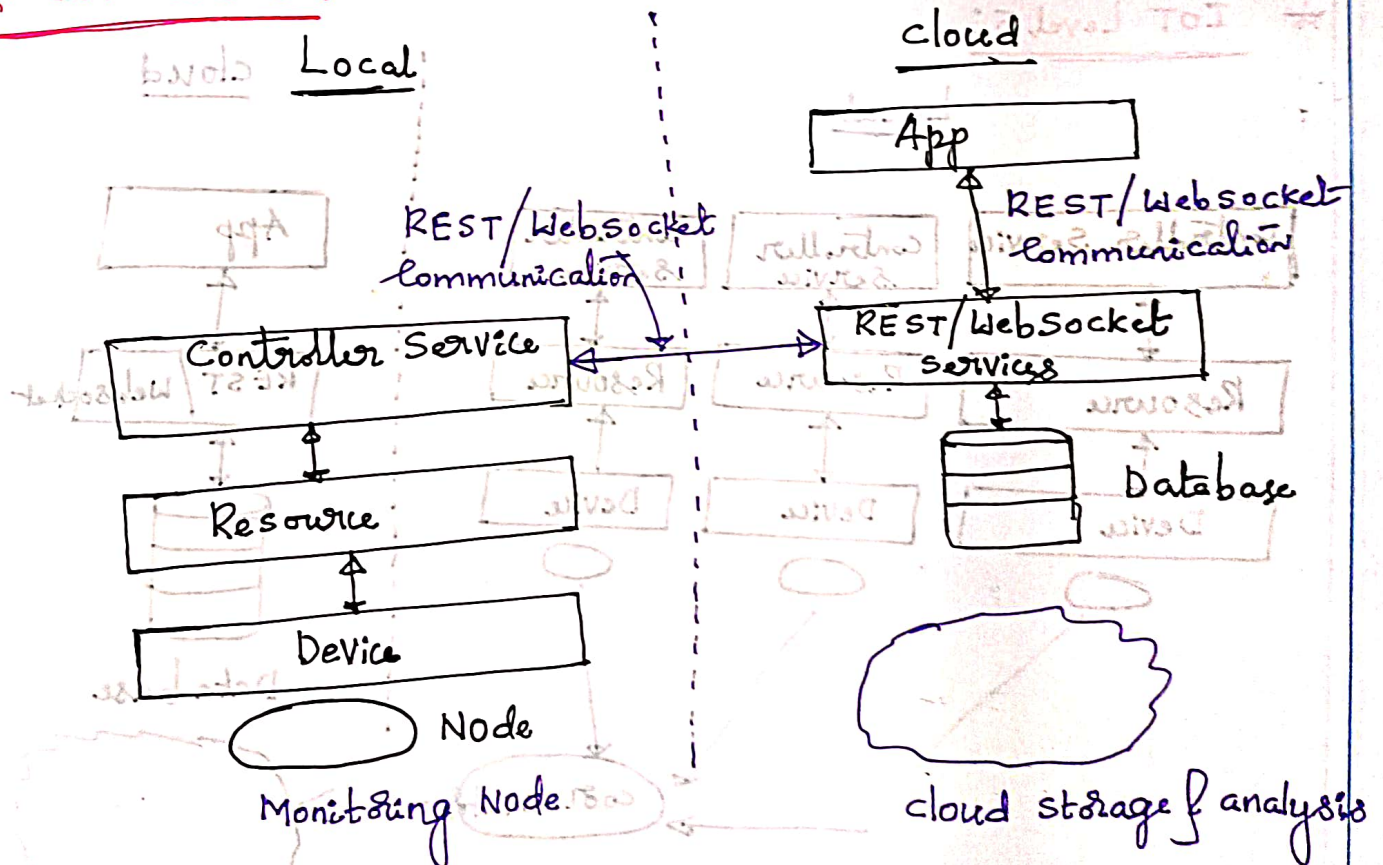Ex: Data filtering, Data mining and Machine learning algorithms

→ **Application:** It enables the processed/analyzed data presented to end users to automate processes and make data driven decisions.
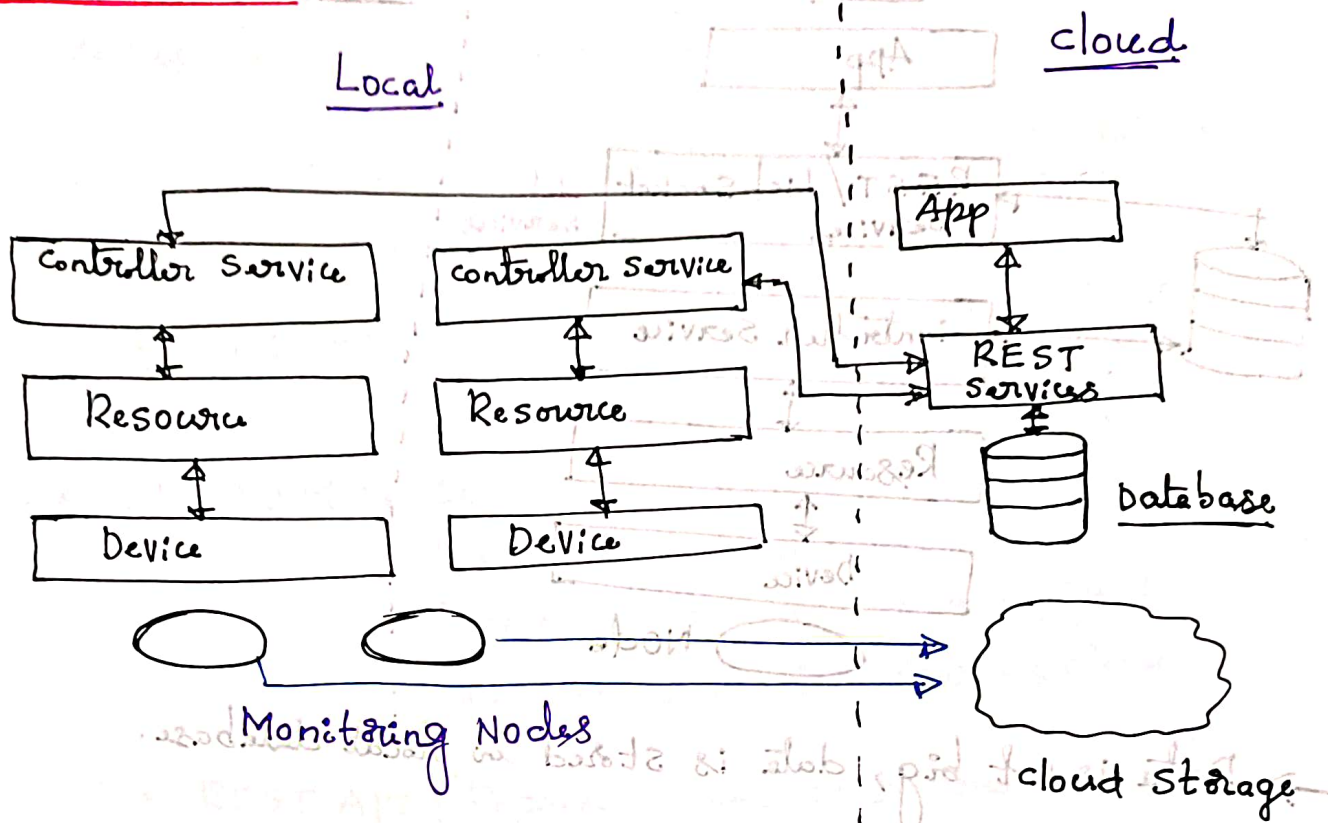
# * IoT Level-1:

Local                                      cloud

```
          ┌──────────────┐
          │     App      │
          └──────────────┘
                 ↕
          ┌──────────────────────┐      Web
          │ REST / WebSocket     │    Services
          │    Services          │
          └──────────────────────┘
       ↗                      ↓
  ┌─────┐    ┌──────────────────────┐
  │ DB  │───→│  Controller Service  │
  └─────┘←───└──────────────────────┘
                    ↕
          ┌──────────────────┐
          │    Resource      │
          └──────────────────┘
                    ↕
          ┌──────────────────┐
          │     Device       │
          └──────────────────┘

          ◯──── Node
```

→ Data is not big, data is stored in local database.

# * IoT Level-2:

Local                                      cloud

```
                                        ┌──────────────────┐
                                        │       App        │
                                        └──────────────────┘
       REST/WebSocket                        ↕ REST/Websocket
        Communication                          Communication
                         ↘           ↗  ┌──────────────────┐
  ┌──────────────────┐    ←─────────→   │  REST/WebSocket  │
  │ Controller Service│                 │    services      │
  └──────────────────┘                  └──────────────────┘
          ↕                                       ↕
  ┌──────────────────┐                   ┌─────┐
  │    Resource      │                   │ DB  │  Database
  └──────────────────┘                   └─────┘
          ↕
  ┌──────────────────┐
  │     Device       │
  └──────────────────┘

     ◯──── Node

  Monitoring Node                    cloud storage & analysis
```

→ Data is big and data is stored in cloud

# * IoT Level 4:

## Local



Controller Service — Resource — Device
Controller Service — Resource — Device

App
REST Services
Database

Monitoring Nodes

cloud Storage

## cloud

---

# * IoT Level 5:

## Local



Controller Service — Resource — Device
Controller Service — Resource — Device
Controller Service — Resource — Device

App
REST/Websocket
Database

coordinator

## cloud

Cloud storage &
Analysis