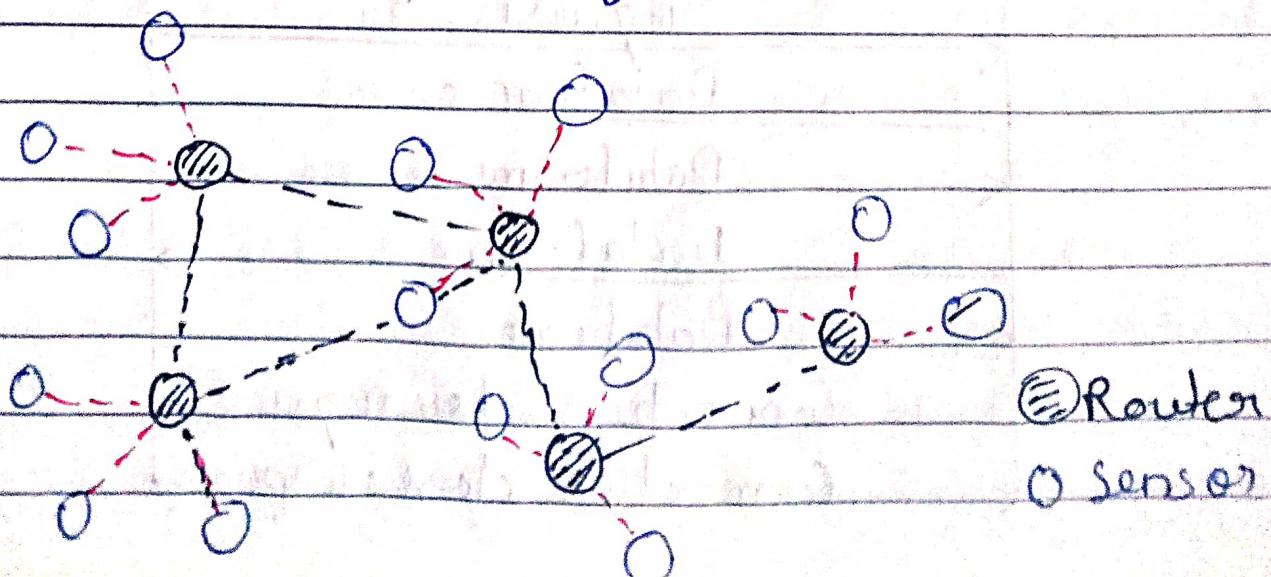


## IoT enabling Technologies

- Wireless Sensor Network (WSN)
  - A WSN comprises of distributed devices with sensors which are used to monitor the environmental and physical conditions.
  - A WSN consists of end nodes, routers and coordinator.
  - End nodes have several sensors attached to them where the data is passed to coordinator with the help of routers.
  - The coordinator also acts as gateway that connects WSN to Internet.

Example- 1) Weather Monitoring System

- 2) Indoor air quality monitoring system
- 3) Soil moisture monitoring System.
- 4) Surveillance systems
- 5) Health monitoring system-



## Cloud computing

→ It is the delivery of different services through the internet, including data storage, servers, databases, networking and software.

→ Characteristics :-

- Broad network access
- On demand self service (can provision additional resources on your own)
- Rapid scalability
- Measured service (Pay on only services used)

→ Provides different services such as:-

- IaaS (servers, networking, storage, and data center space on a pay per use basis)
- PaaS (provides a cloud based environment with everything required to support the complete life cycle of building and delivering web based (cloud) applications - without the cost and complexity of buying and managing underlying hardware, software, provisioning and hosting)
- SaaS (is a way of delivering app. over the internet as a service. Instead of installing and maintaining software, you simply access it via the Internet, freeing yourself from complex

software and hardware management.

SaaS applications are sometimes called web based software, on demand software or hosted software.

SaaS applications run on a SaaS provider's servers and they manage security, availability and performance.

### • Big Data Analytics

- It refers to the strategy of analyzing large volumes of data or big data.
- Big data is gathered from a variety of sources including social networks, videos, digital images, sensors and sales transaction records.
- Several steps involved in analyzing big data are - data cleansing, munging, processing & and visualization.

Example - 1) Sensors data generated by W.M.S

- 2) Data generated by IoT systems for location and tracking of vehicles.
- 3) Sensors embedded in industry and energy system.

4) Health and fitness data generated by IoT system such as fitness bands.

- Embedded Systems

- It is a combination of hardware and software system used to perform special tasks.
- It includes microcontroller/microprocessor, memory (RAM, ROM), networking units (Ethernet, WiFi adapters), input/output units (display, keyboard etc), storage system (Flash memory).
- It collects the data & sends it to internet.

## IoT Levels and Deployment Templates

IoT System consists of following components.

Device- An IoT device allows identification, remote sensing, remote monitoring capabilities.

Resource- Software components on IoT device for accessing, processing and storing data.  
→ Controlling actuators.

→ Enabling network access for the device

Controller Service - Sends data from the device to the web service and receives commands from the application for controlling device.

Database - can be local or cloud and stores the data generated by the IoT device.

Web Service - Serves as a link between the IoT device, application, database and analysis components.

→ Can be implemented by HTTP & REST principle or using Web socket protocol.

Analysis Component - responsible for analyzing the IoT data and generating results in the form that is easy to understand for user.

Application - provides an interface that the user can use to control and monitor various aspects of the IoT system.

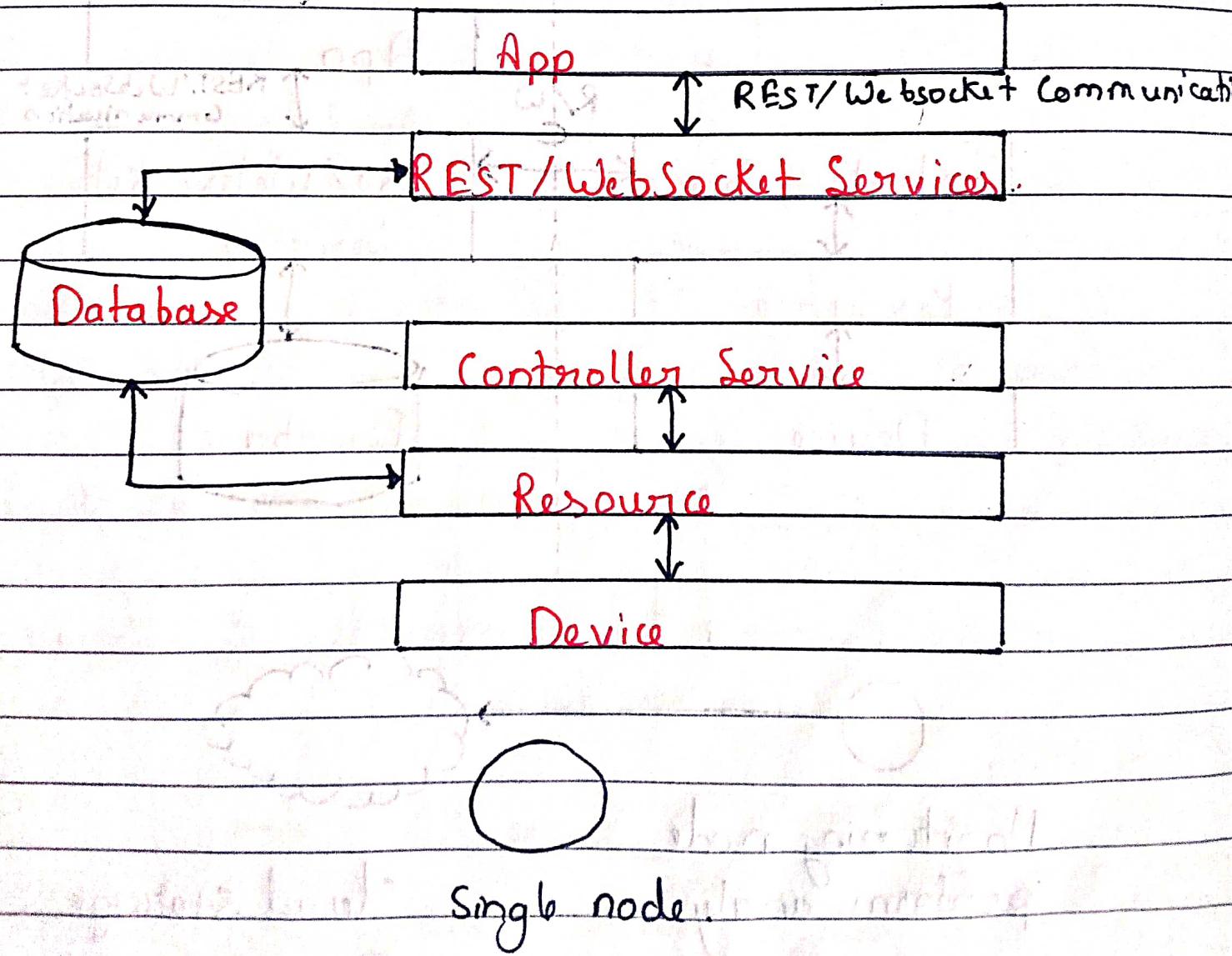
→ It also allows users to view the system status and the processed data.

## IoT level-1

- It has a single node / device that performs sensing, stores data, perform analysis and hosts the application.
- Suitable for modelling low level cost and low complexity solutions where the data involved is not big & the analysis requirements are not computationally intensive.

Example - Home automation system.

Local

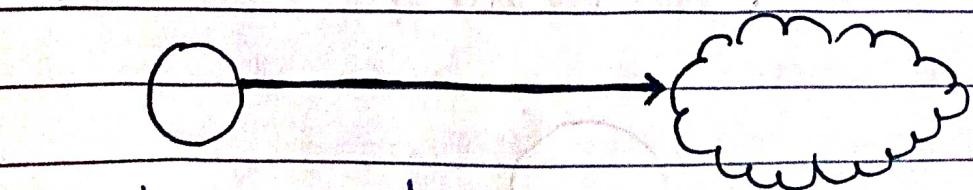
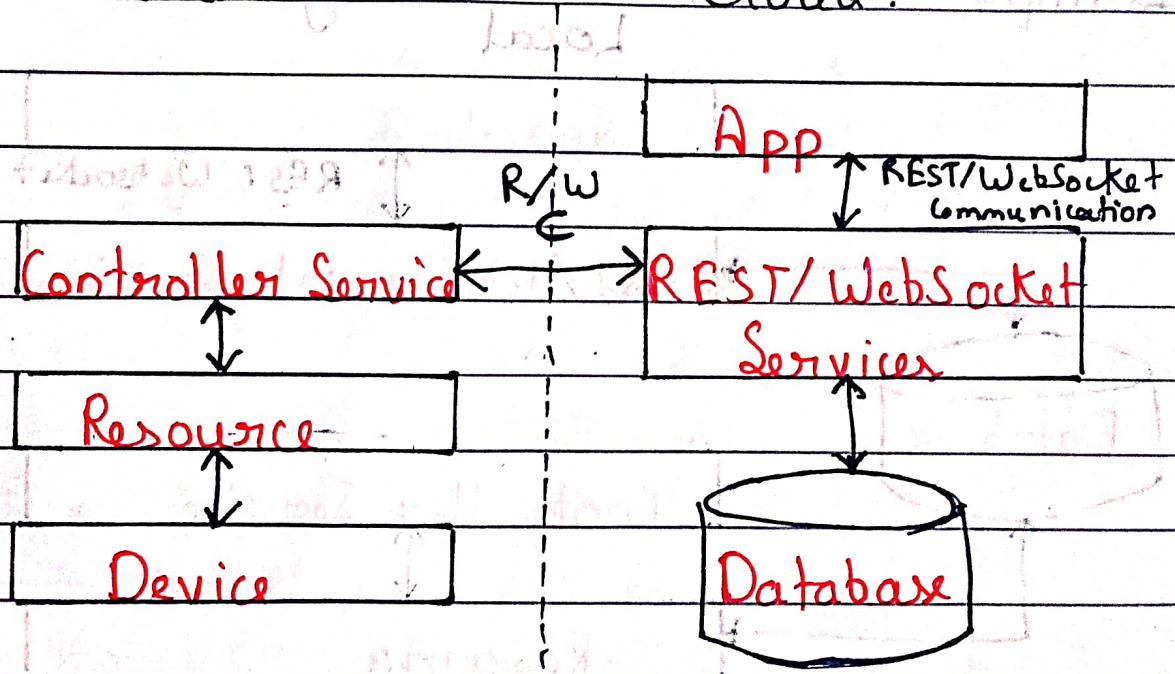


## IoT Level-2

- Single node
- Data is stored in the cloud & the app. is usually cloud based.
- Data involved is big.
- Not computationally intensive.

Example - Smart Irrigation

Local Cloud



Monitoring node

perform analysis

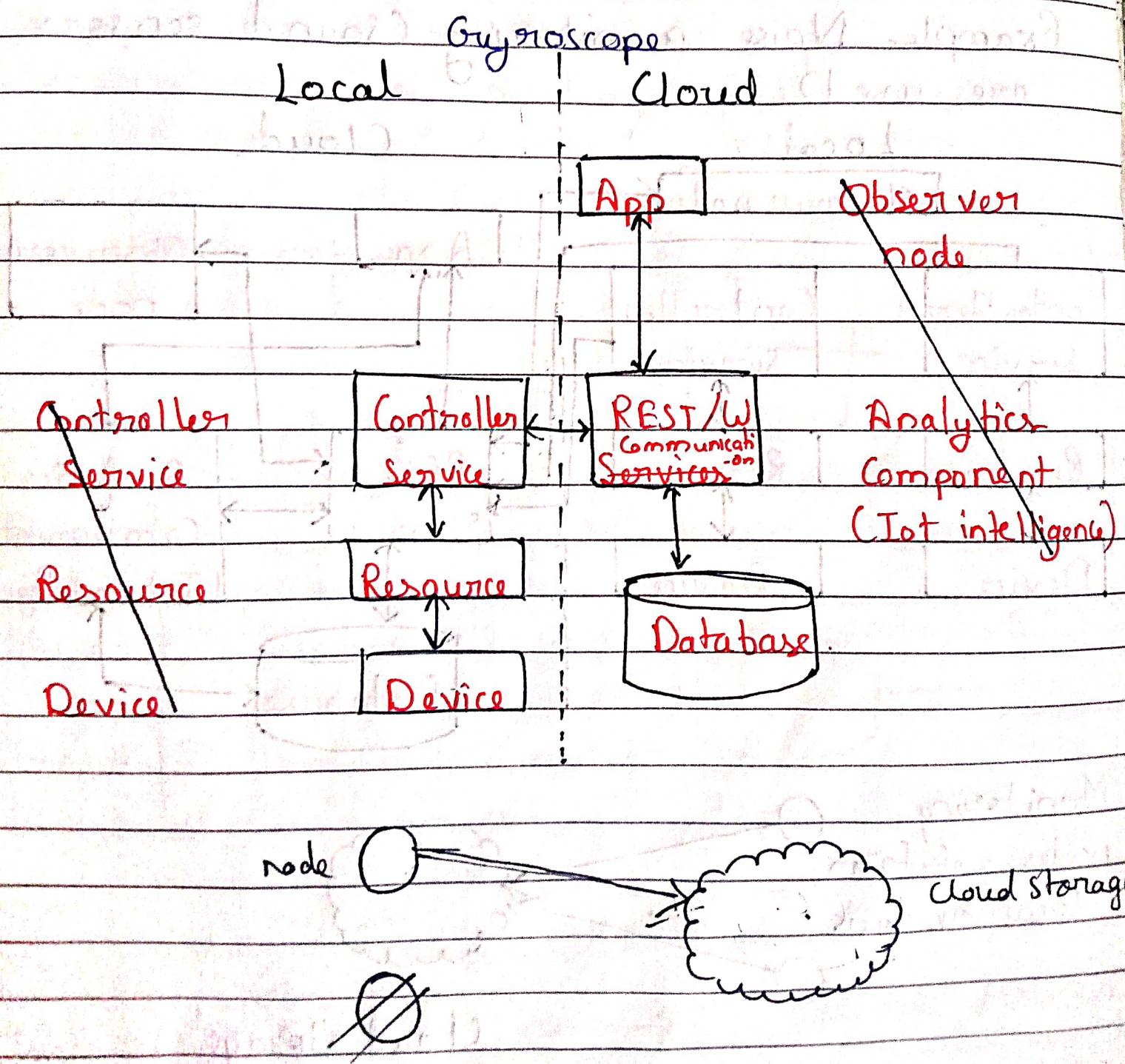
cloud storage

### IoT Level 3

- Single node, stored in cloud
- Data involved is big, analysis requirements are computationally intensive.

Example - Tracking package handling.

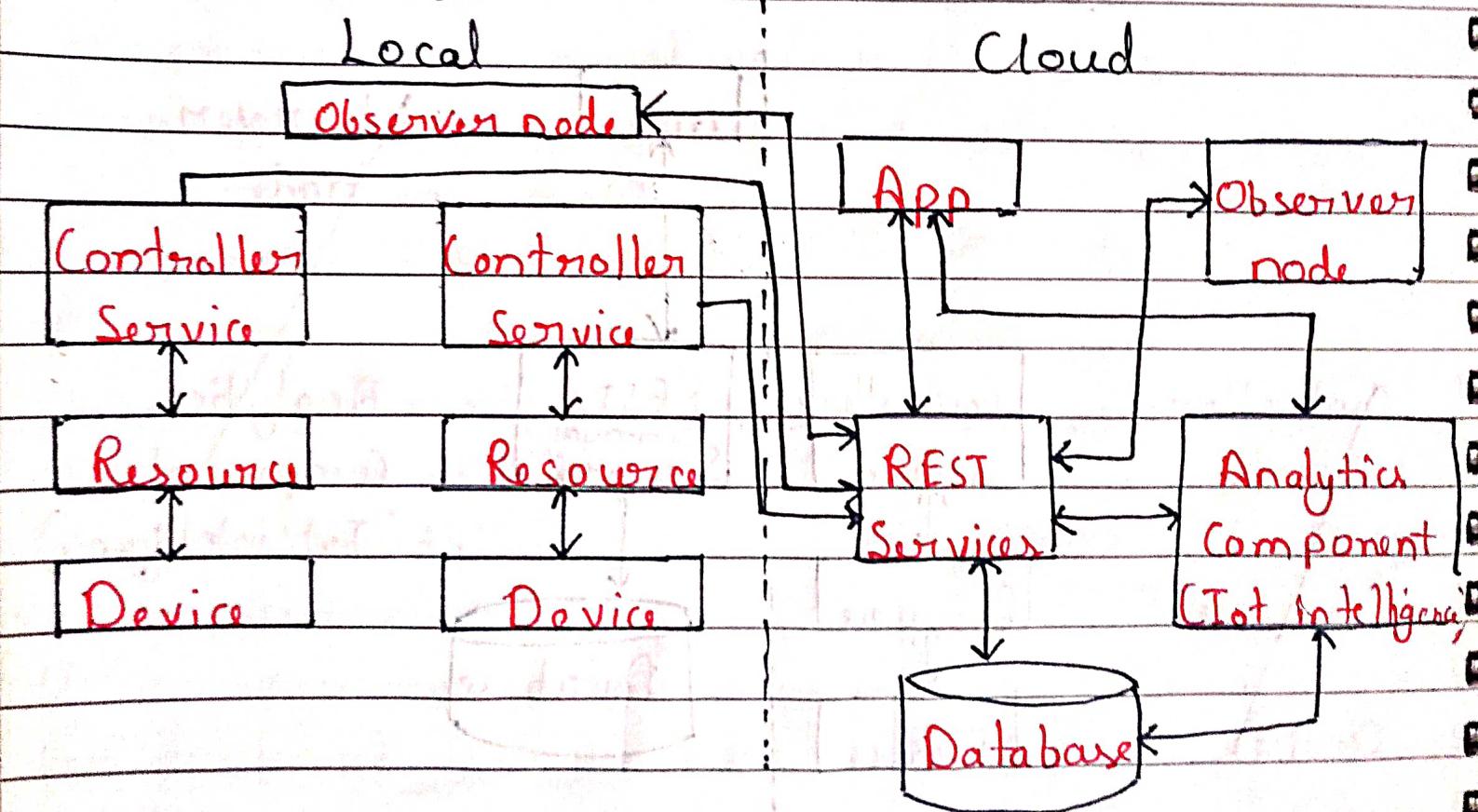
Sensors used - Accelerometer



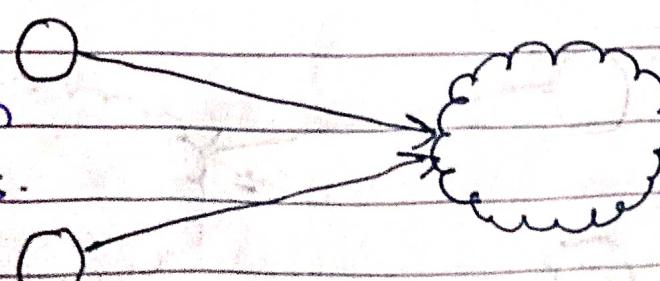
## IoT Level-4

- Multiple nodes perform local analysis
- Contains local & cloud based observer nodes, which can subscribe and receive information collected in the cloud from IoT devices
- data big, C. I.

Example- Noise monitoring (Sound sensors are used)



Monitoring nodes perform local analysis.

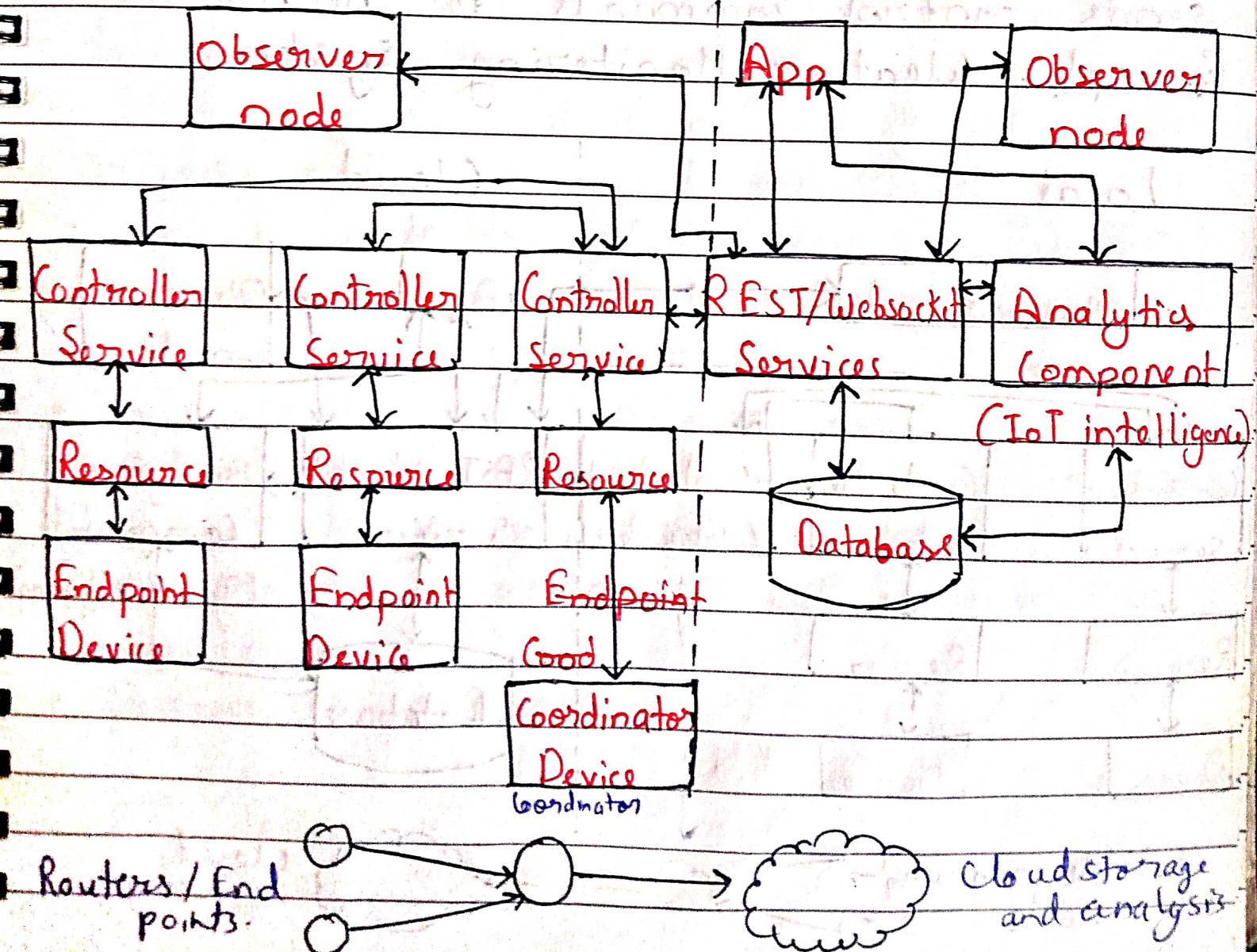


## IoT Level-5

- Multiple nodes and one coordinator node.
- Coordinator node collects data from the end nodes and sends it to the cloud.
- Data Level 5 IoT systems are suitable for solutions based on wireless sensor networks.

Example - Forest fire Detection

Sensors measure the temp, smoke, weather, location etc off the cloud.



## IoT Level-6

- Multiple nodes that perform sensing and/or actuation and send data to the cloud.
- The analytics component analyzes the data and stores the results in the cloud database.
- The results are visualized with the cloud based application.
- The centralized controller is aware of the status of all the end nodes and sends control commands to the nodes.

Example - Weather Monitoring System.

