S COLLEGE OF TECHNOLO

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Internet of Things

Department of Computer Applications

COURSE : 19CAE725 : Internet of Things

UNIT II : Application Development

CLASS : II Semester / I MCA

IOT Platform Design Methodology

IOT Design Methodology Includes

- Purpose and Requirement Specification
- Process Specification
- Domain Model Specification
- Information Model Specification
- Service Specification
- IOT Level Specification
- Functional View Specification
- Operational View Specification
- Device and Component integration


Purpose & Requirements
Define Purpose & Requirements of IoT system
Process Model Specification
Define the use cases
Domain Model Specification
Define Physical Entities, Virtual Entities, Devices, Resources and Services in the IoT system
Information Model Specification
Define the structure (e.g. relations, attributes) of all the information in the IoT system
Service Specifications
Map Process and Information Model to services and define service specifications
IoT Level Specification
Define the IoT level for the system
Functional View Specification
Map IoT Level to functional groups
Operational View Specification
Define communication options, service hosting options, storage options, device options
Device & Component Integration
Integrate devices, develop and integrate the components
Application Development
Develop Applications

Purpose and Requirement Specification

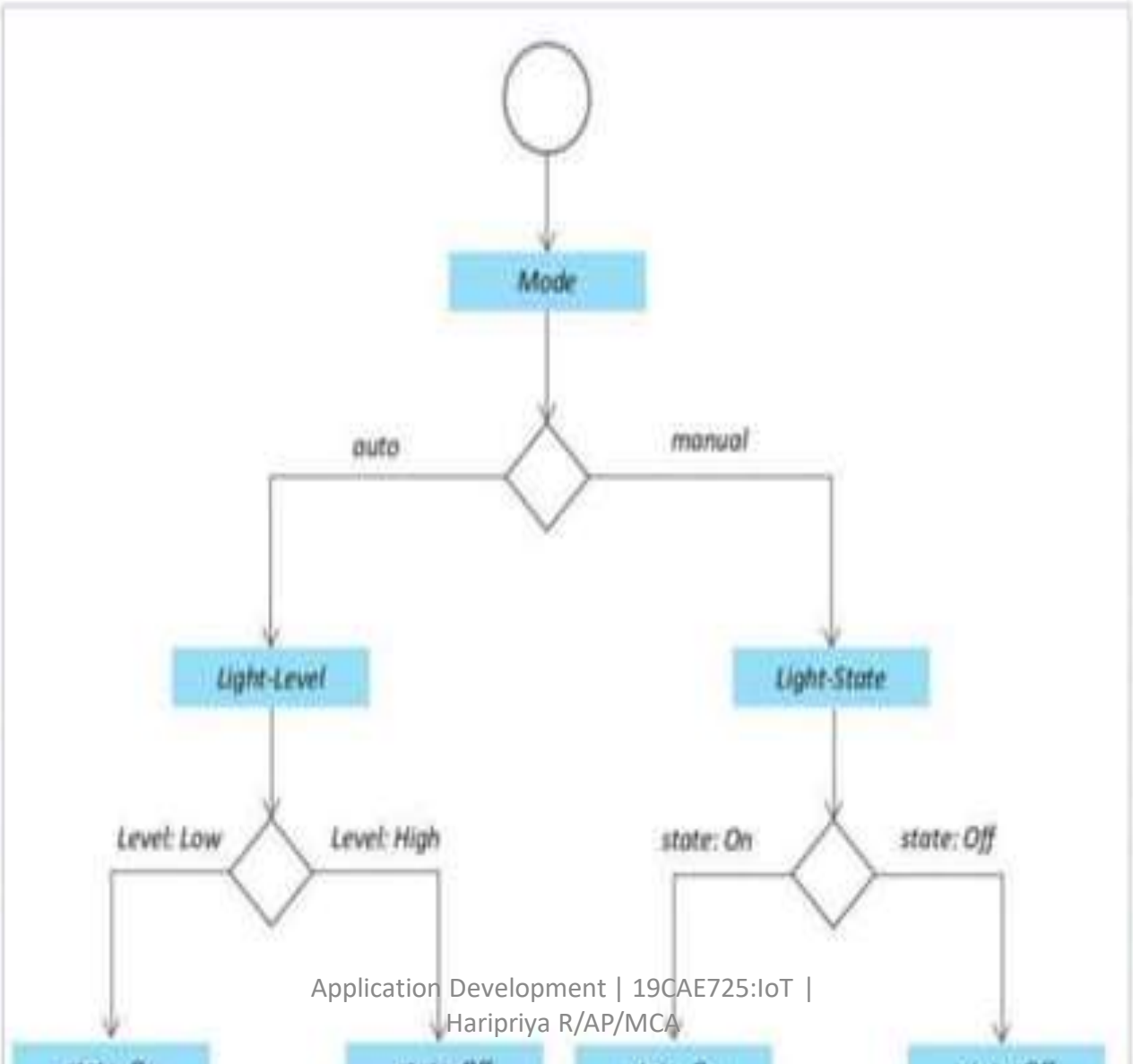
Process Specification

Purpose & Requirements Specification

The first step in IOT system design methodology is to define the purpose and requirements of the system. In this step, the system purpose, behavior and requirements (such as data collection requirements, data analysis requirements, system management requirements, data privacy and security requirements, user interface requirements, ...) are captured.

Process Specification

The second step in the IoT design methodology is to define the process specification. In this step, the use cases of the IoT system are formally described based on and derived fromthe purpose and requirement specifications.


Mode
auto
manual
Light-Level
Light-State
Level: Low
Level: High
state: On
state: Off

Domain model Specification

Information model specification

Domain model Specification

- The domain model describes the main concepts, entities and objects in the domain of IoT system to be designed.
- Domain model defines the attributes of the objects and relationships between objects. Domain model provides an abstract representation of the concepts, objects and entities in the IoT domain, independent of any specific technology or platform. With the domain model, the IoT system designers can get an understanding of the IoT domain for which the system is to be designed.

Domain model Specification

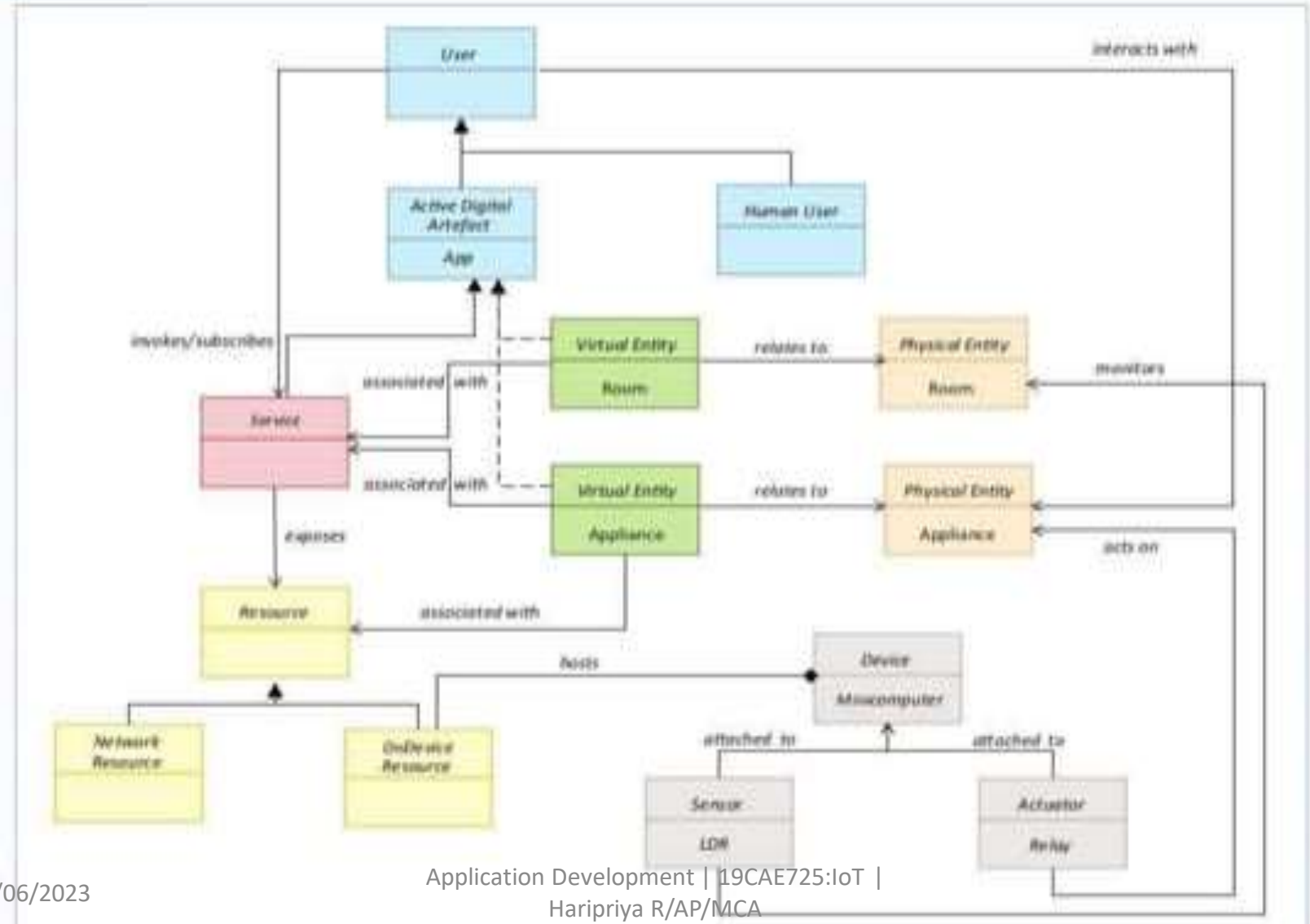
The entities, objects and concepts defined in the domain model include:

- **Physical Entity** : Physical Entity is a discrete and identifiable entity in the physical environment (e.g. a room, a light, an appliance, a car, etc.).
- **Virtual Entity** : Virtual Entity is a representation of the Physical Entity in the digital world.
- **Device** :provides a medium for interactions between Physical Entities and Virtual Entities. Devices are either attached to Physical Entities or placed near Physical Entities.

Domain model Specification

- **Resource** : Resources are software components which can be either "on-device" or "network-resources". On-device resources are hosted on the device and include software components that either provide information on or enable actuation upon the Physical Entity to which the device is attached.

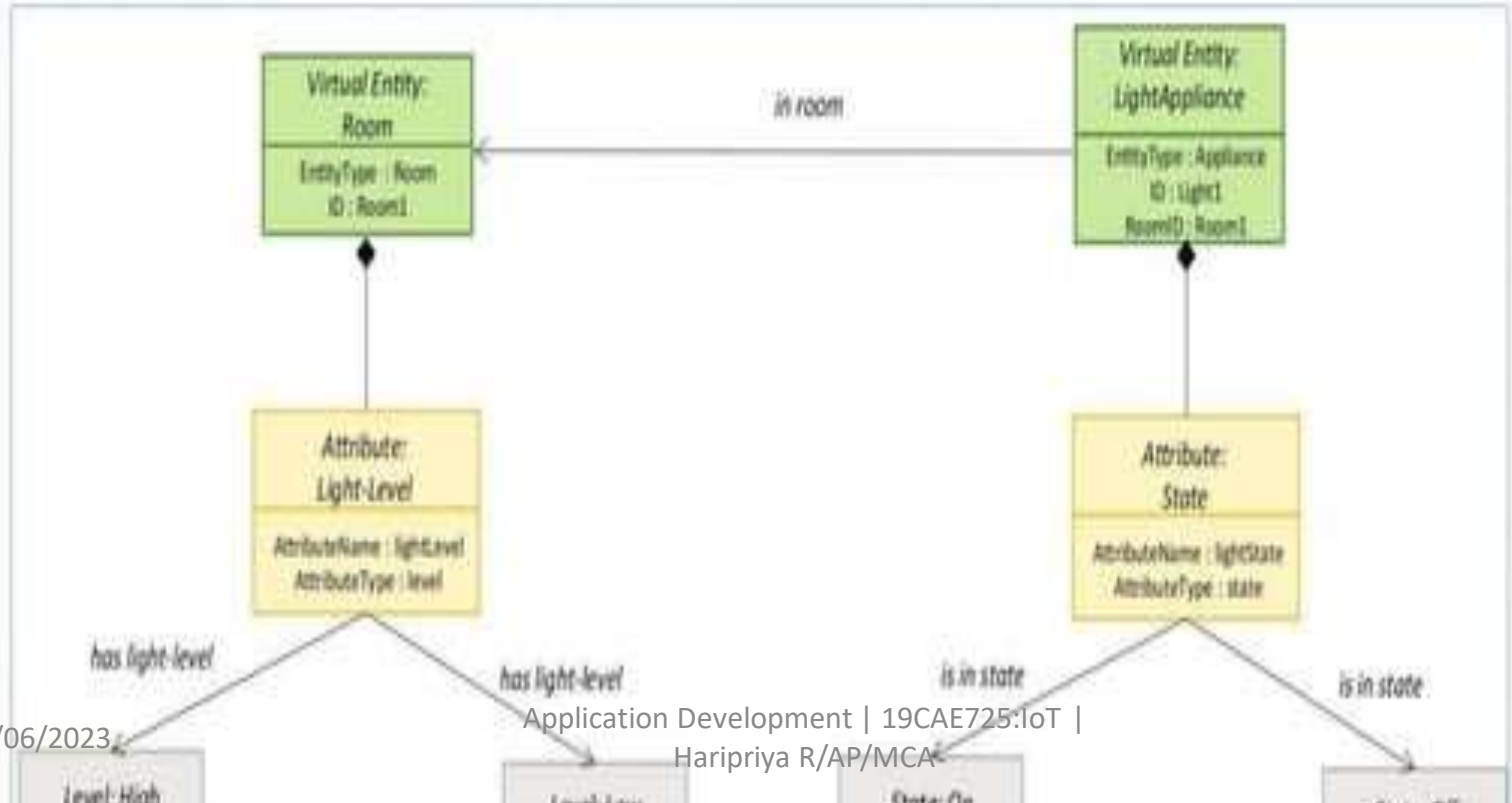
- **Service** : Services provide an interface for interacting with the Physical Entity. Services access the resources hosted on the device or the network resources to obtain information about the Physical Entity or perform actuation upon the Physical Entity.


User
interacts with
Active Digital Artefact
App
Human User
invoke/subscribes
Virtual Entity
Room
relates to
Physical Entity
Room
monitors
associated with
Service
associated with
Virtual Entity
Appliance
relates to
Physical Entity
Appliance
acts on
exposes
Resource
associated with
hosts
Device
Microcomputer
Network Resource
OnDevice Resource
attached to
attached to
Sensor
LDR
Actuator
Relay

Information model specification

- Information Model defines the structure of all the information in the IoT system, for example, attributes of Virtual Entities, relations, etc.
- Information model does not describe the specifics of how the information is represented or stored. To define the information model, we first list the Virtual Entities defined in the Domain Model.
- Information model adds more details to the Virtual Entities by defining their attributes and relations.

Information model specification

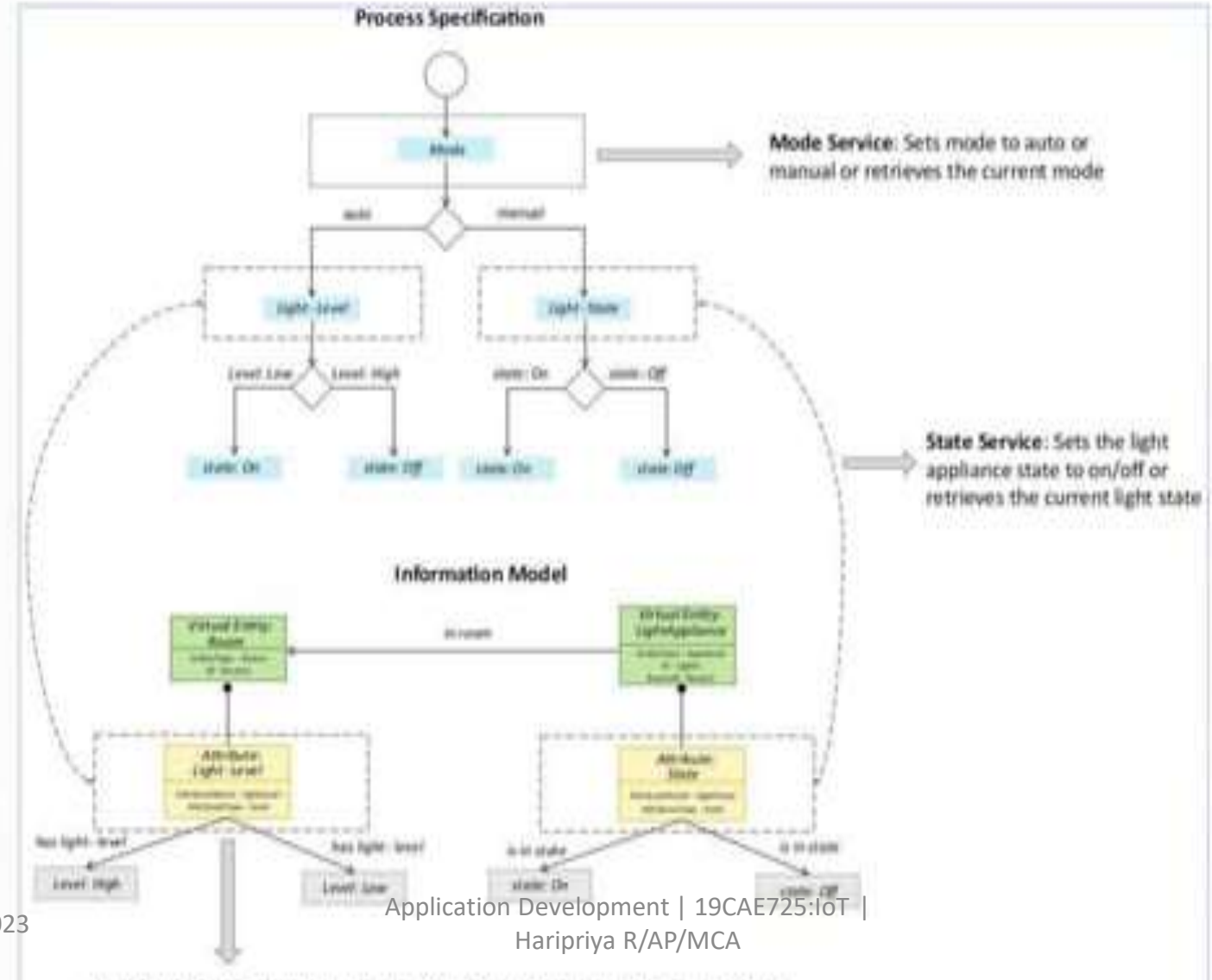


Service Specifications

IOT Level Specification

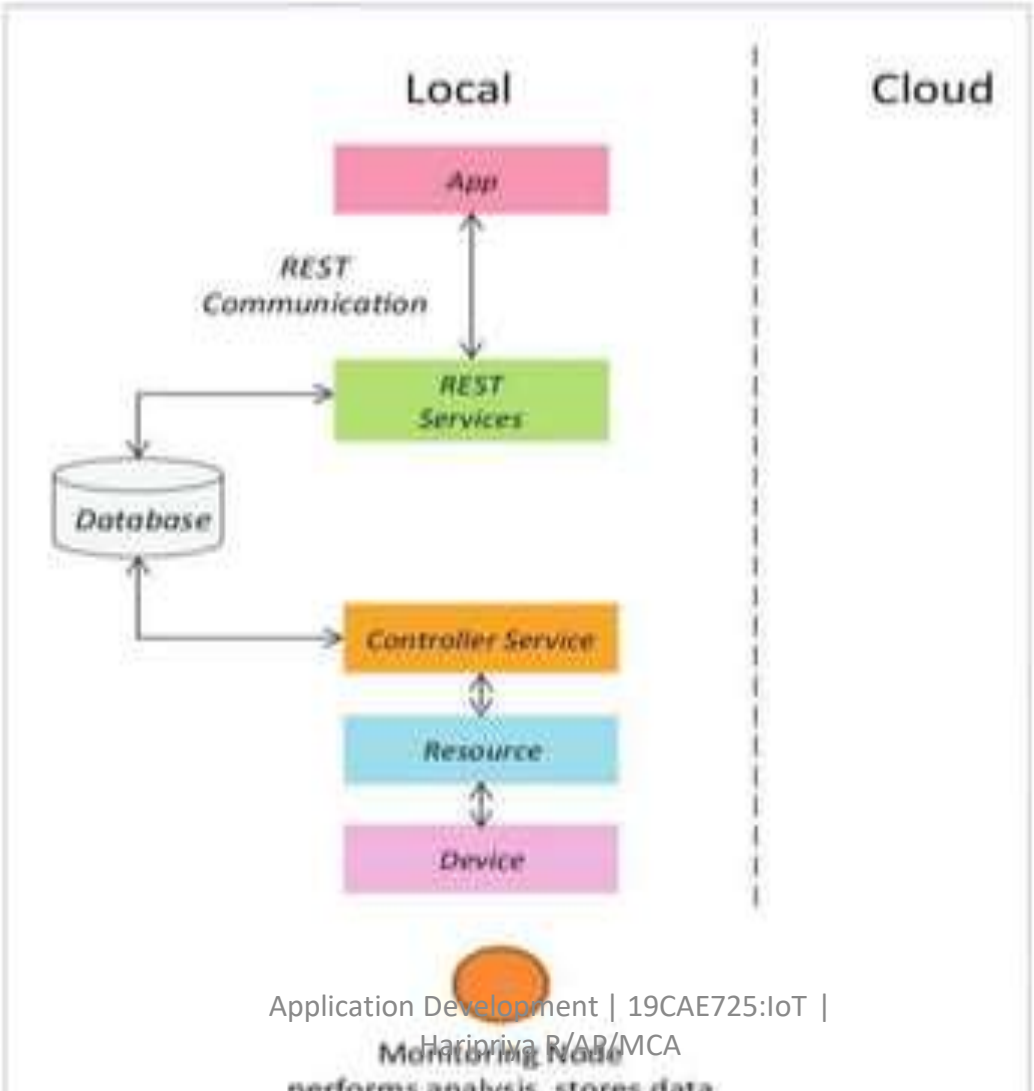
Service Specifications

- The fifth step in the IoT design methodology is to define the service specifications. Service specifications define the services in the IoT system, service types, service inputs/output, service endpoints, service schedules, service preconditions and service effects.


Process Specification
Mode Service: Sets mode to auto or manual or retrieves the current mode
State Service: Sets the light appliance state to on/off or retrieves the current light state
Information Model

IOT Level Specification

- The sixth step in the IoT design methodology is to define the IoT level for the system. In Chapter-1, we defined five IoT deployment levels


Local
Cloud
App
REST
Communication
REST
Services
Database
Controller Service
Resource
Device

Functional view Specification

Operational view Specification

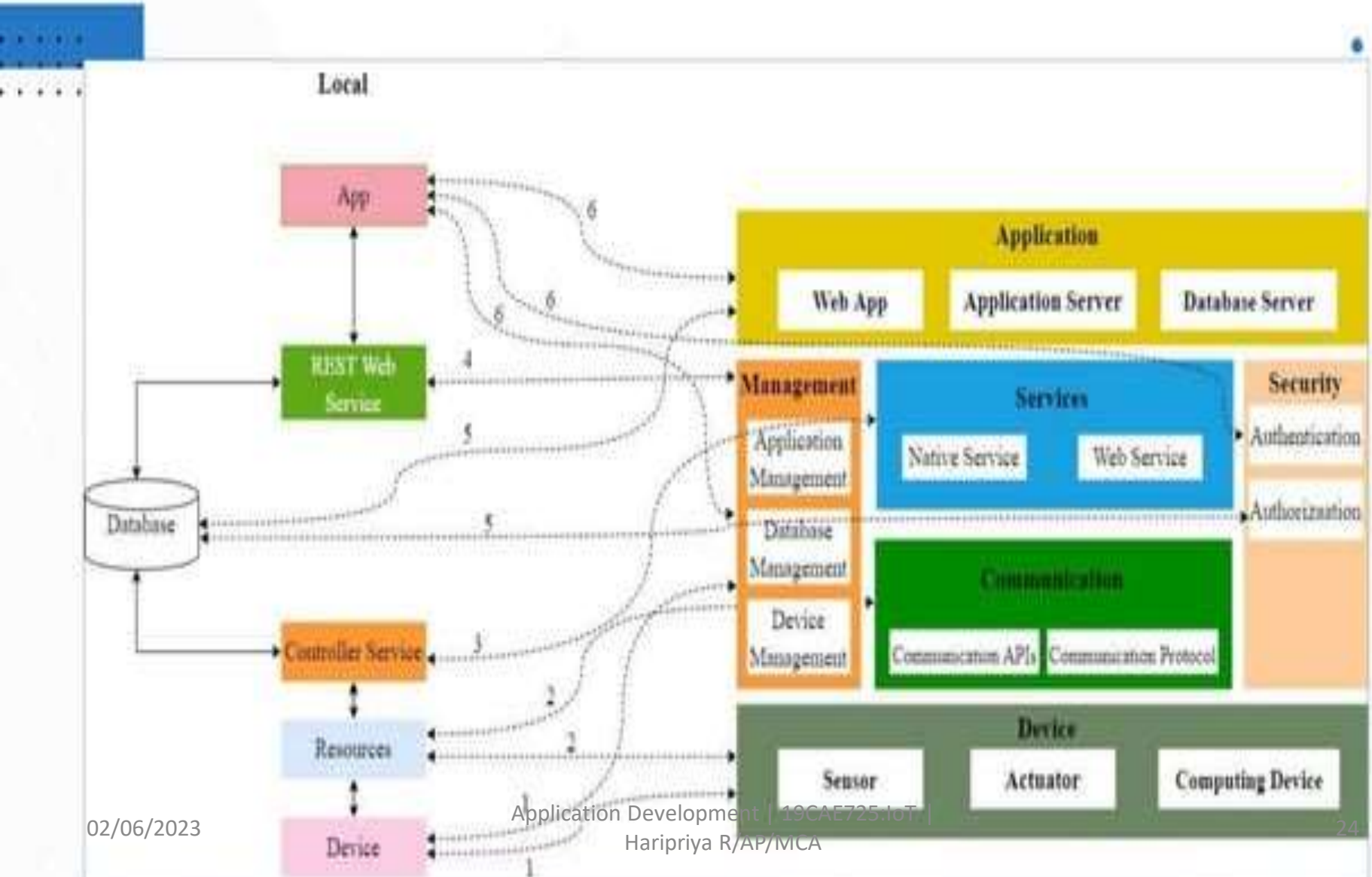
Functional view Specification

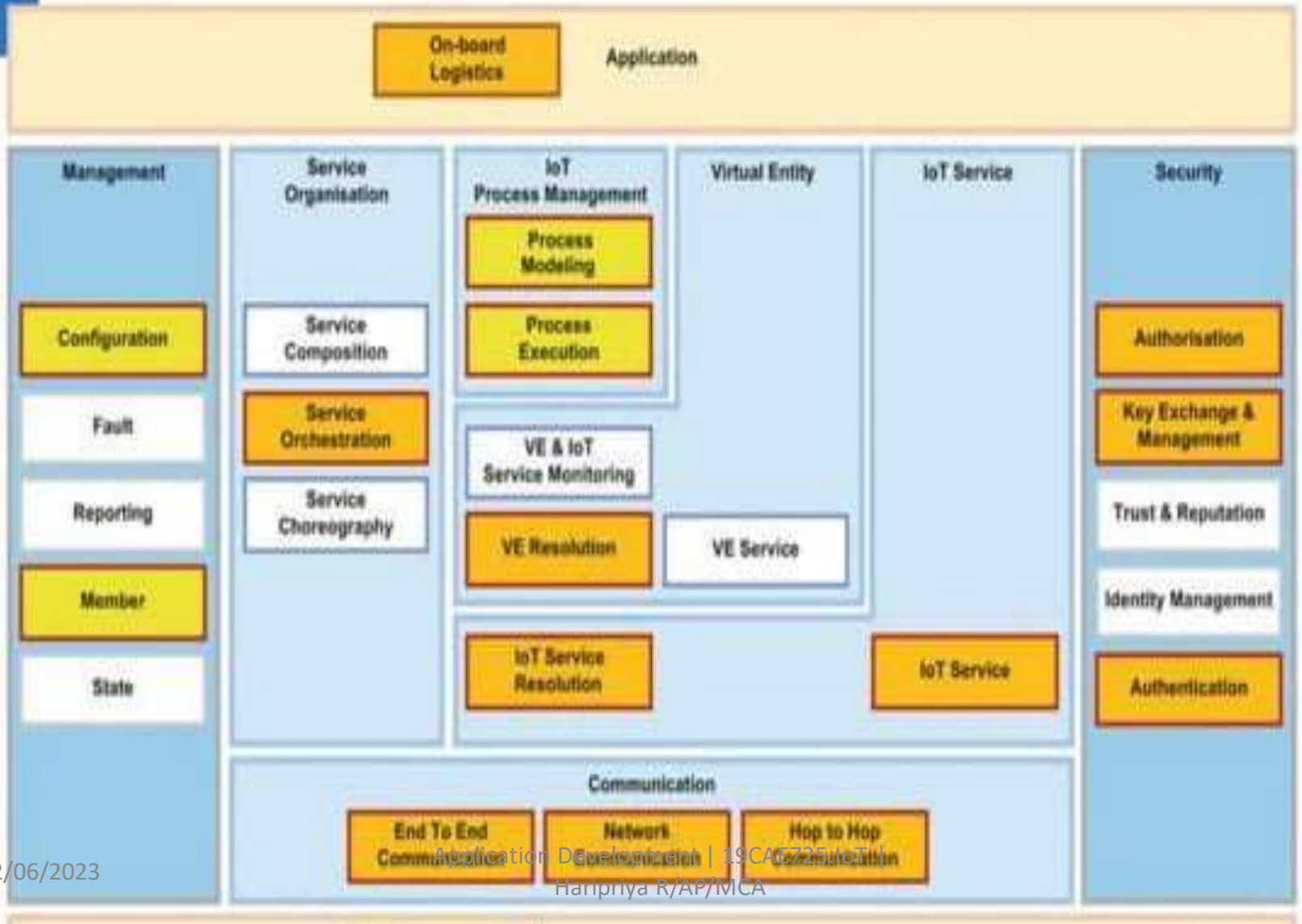
The Functional Groups (FG) included in a Functional View include:

- **Device** : The device FG contains devices for monitoring and control. In the home automation example. the device FG includes a single board mini-computer, a light sensor and relay switch(actuator).
- **Communication** : The communication FG handles the communication for the IoT system. The communication FG includes the communication protocols that form the backbone of IoT systems and enable network connectivity.
- The communication FG also includes the communication APis (such as REST and WebSocket) that are used by the services and applications to exchange data over the network.

Functional view Specification

- **Services** : The service FG includes various services involved in the IoT system such as services for device monitoring , device control services, data publishing **services and services for device discovery.**
- **Management** : The management FG includes all functionalities that are needed to configure and manage the loT system .
- **Security** : The security FG includes security mechanisms for the loT system such as authentication, authorization, data security, etc.
- **Application** : The application FG includes applications that provide an interface to the users to control and monitor various aspects of the IoT system. Applications also allow users to view the system status and the processed data.


Local
App
REST Web Service
Database
Controller Service
Resources
Device
6
6
6
4
5
5
3
2
2
1
1
Application
Web App
Application Server
Database Server
Management
Application Management
Database Management
Device Management
Services
Native Service
Web Service
Communication
Communication APIs
Communication Protocol
Security
Authentication
Authorization
Device
Sensor
Actuator
Computing Device


On-board Logistics
Application
Management
Configuration
Fault
Reporting
Member
State
Service Organisation
Service Composition
Service Orchestration
Service Choreography
IoT Process Management
Process Modeling
Process Execution
VE & IoT Service Monitoring
VE Resolution
Virtual Entity
VE Service
IoT Service Resolution
IoT Service
IoT Service
Security
Authorisation
Key Exchange & Management
Trust & Reputation
Identity Management
Authentication
Communication
End To End
Network
Hop to Hop

Operational View Specification

Operation view address how an actual system can be realized by using devices and technologies among many options and making them communicate and operate in an efficient manner.

Devices options: Arduino, PIR Sensor, LED. Buzzer, Camera, Raspberry PI are needed for further enhancement.

Communication options: network layer-IPV4, MQTT

Services options: Web Service.

Operational View Specification

Application options: It is out of scope for the project but as discussed earlier, Node-red web application can be realized.

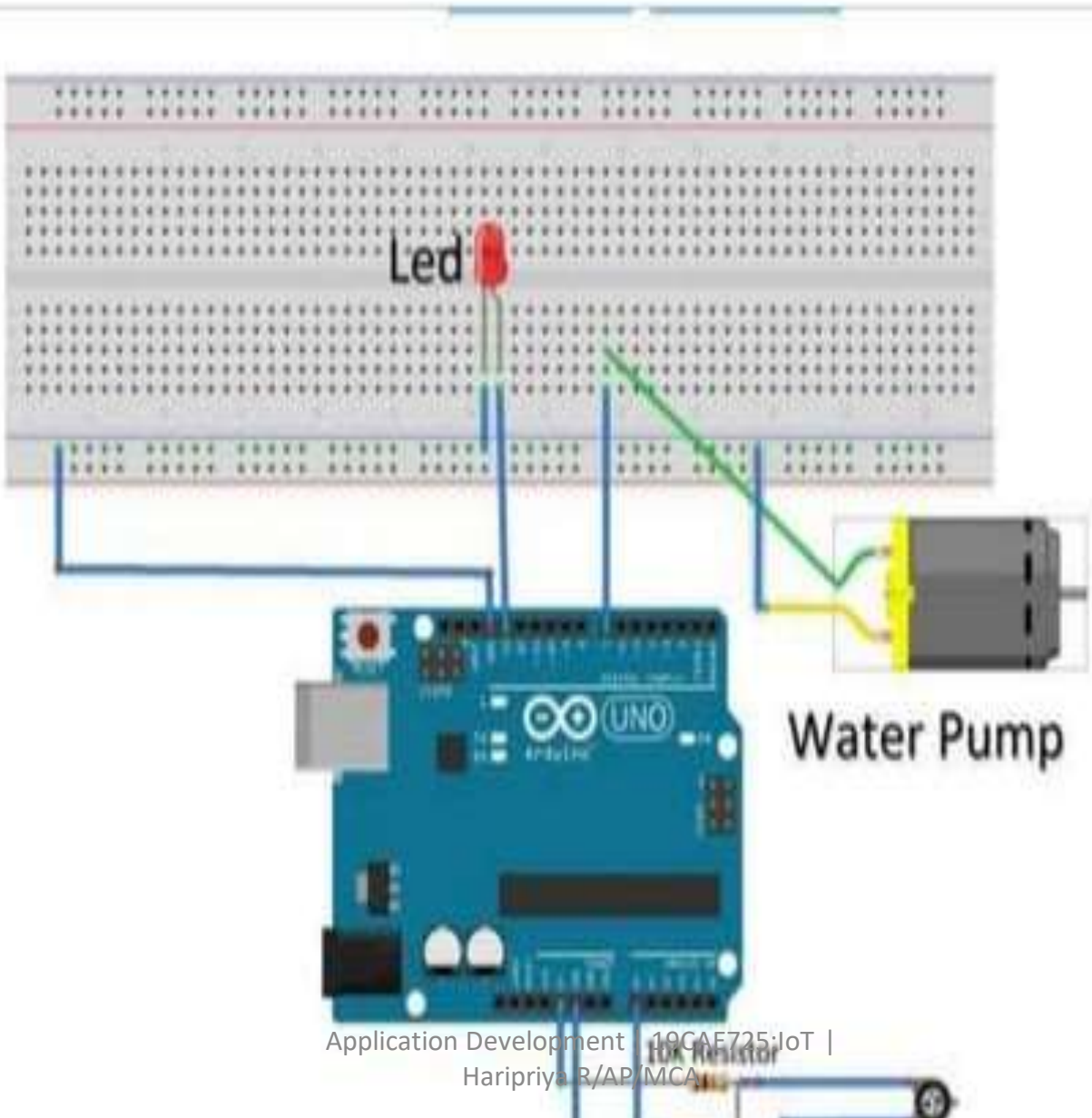
Security options: Two-phase authentication and authorization.

Device and Component Integration: This section is all about integrating the devices and components. The devices and components used in are Arduino, PIR sensor, and LED.

Device and Component Integration

Device and Component Integration

- The ninth step in the IoT design methodology is the integration of the devices and components.
- It integrates the devices and components and draws a schematic diagram showing the same.
- The following diagram shows the component & device integration.


Led
UNO
Water Pump
10k Resistor

Application Development

Application Development

- The final step in the IoT design methodology is to develop the IoT application.
- Application development is the process of designing, building, and implementing software applications. It can be done by massive organizations with large teams working on projects, or by a single freelance developer. Application development defines the process of how the application is made, and generally follows a standard methodology.

Examples of IoT in Real Life

Wearable Health Monitors

Disaster Management

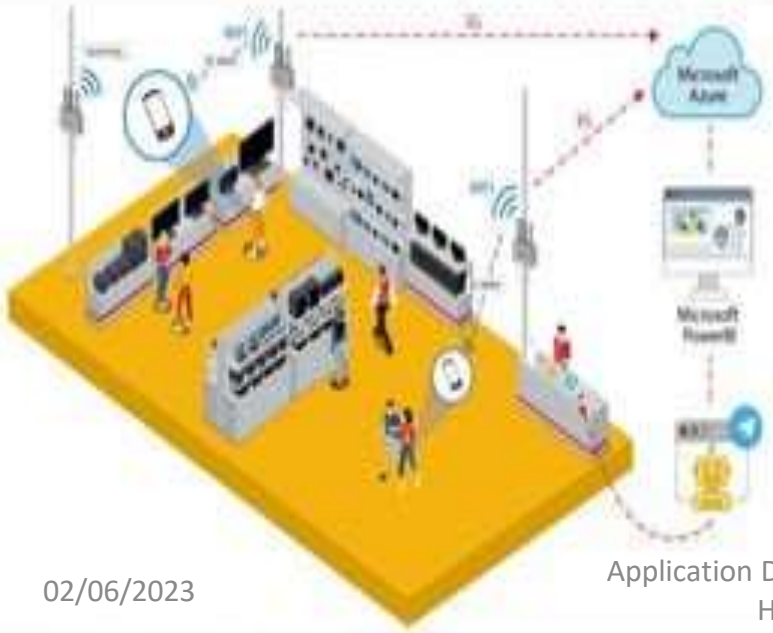
Examples of IoT in Real Life

Biometric Security Systems

Smart Cars

Examples of IoT in Real Life

Shopping Malls



Farming

THANK YOU