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R. H. Sapat College of Engineering, Management Studies and Research,
Nashik - 422 005, (M.S.), INDIA

Problem Statement 3 :Write the process and Design, Intrusion Detection System (IDS) for Home.

Class: TE Div: A

By,

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Step 1: Purpose and Requirement Specification:

Purpose: The purpose of home intrusion detection system is to detect intrusions using sensors and raise alerts, if necessary.

Requirements:

ESP12E NodeMCU board

Raspberry Pi

PIR sensor

Light dependent Resistor

Laser pointer

Web cam

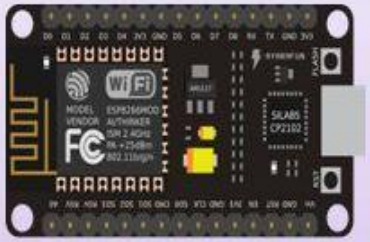
Buzzer

Some wires

Requirements

Computing Devices

Node MCU



Raspberry Pi

Sensors

PIR-Motion Sensor

Light-Dependent Resistor

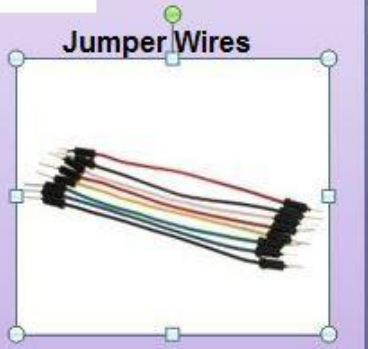
Laser Pointer

USB Camera

Buzzer

LED

Jumper Wires



- **Behavior:**
- In case of any intrusion, I intend to capture a picture of the intruder, mail the image to the respective end users and alert them. I would like to use an alarm which goes on in case of an intrusion.

- **Work-Flow:**
- Using all the above requirements, I am going to detect the intrusion that is:
- With the help of ***Light dependent resistor and PIR motion sensor***, I am going to detect the motions in the room.
- If a motion is detected, I intend to capture the image with the help of a ***webCam*** and store locally
- Now the alerts are sent to the user with the captured image.
- Also I am using the buzzer which turns on in case of any intrusion.

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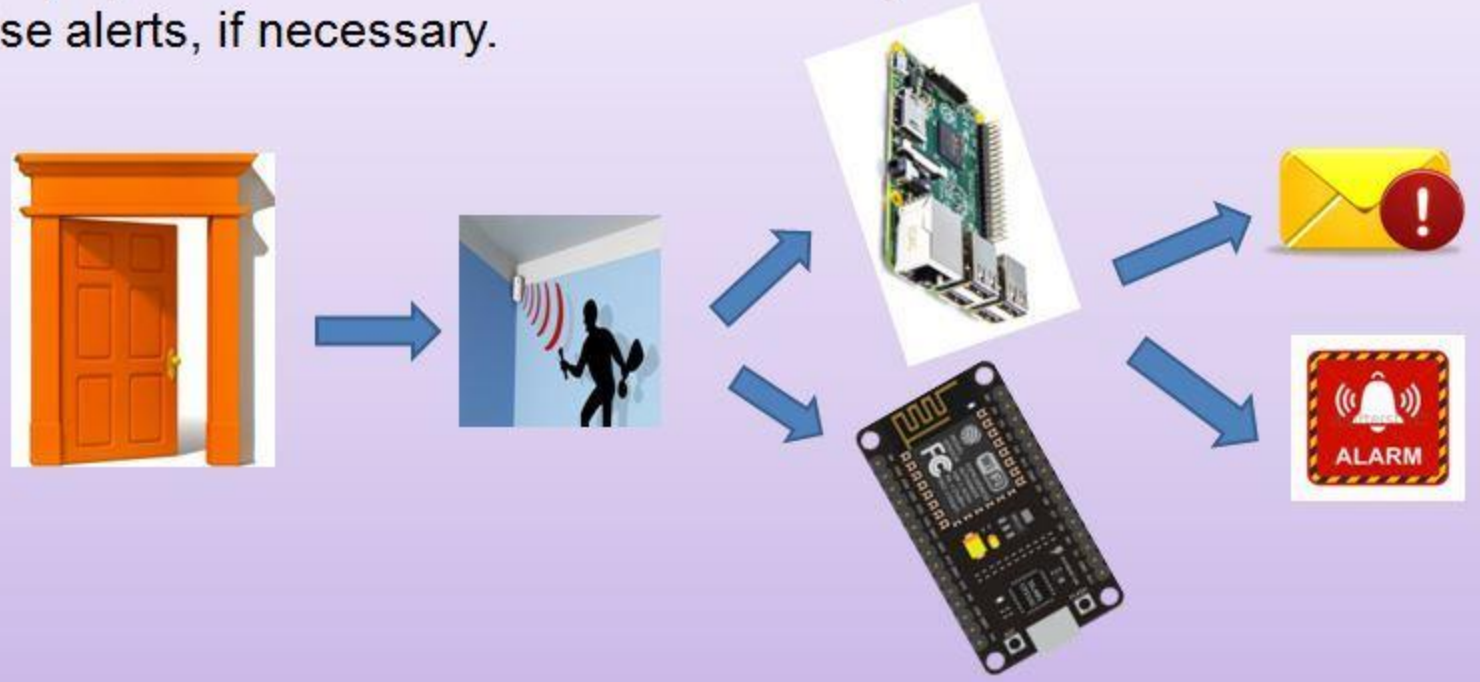
OBJECTIVE

The purpose of home intrusion detection system is to detect intrusions using sensors and raise alerts, if necessary.

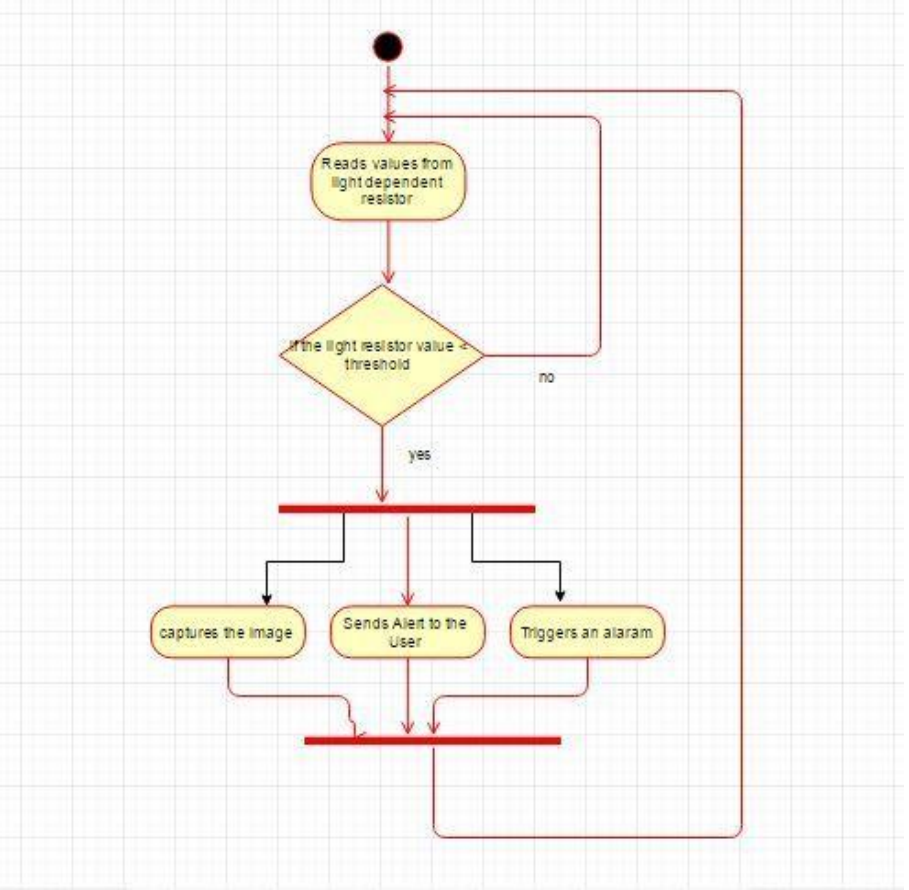


- **Data Analysis Requirement:**
- The light dependent resistor data is analyzed locally. If the sensor reading falls below the threshold value, an image is captured and send as an alert to the user.

- **Application Deployment Requirement:**
- The application is deployed locally on the device and can be accessible from anywhere via node-red.

STEP 2: Process Specification:

The process diagrams for home intrusion detection system are as shown below:



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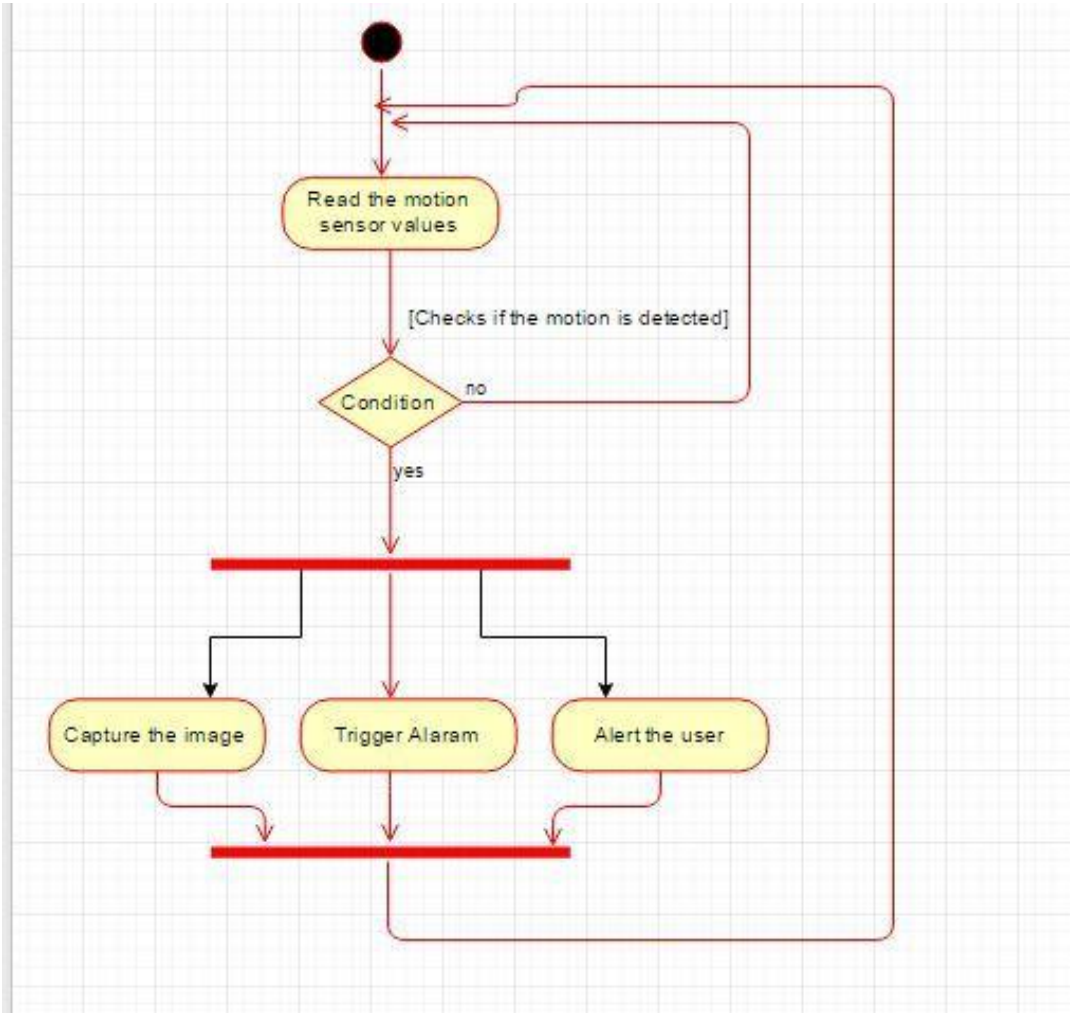
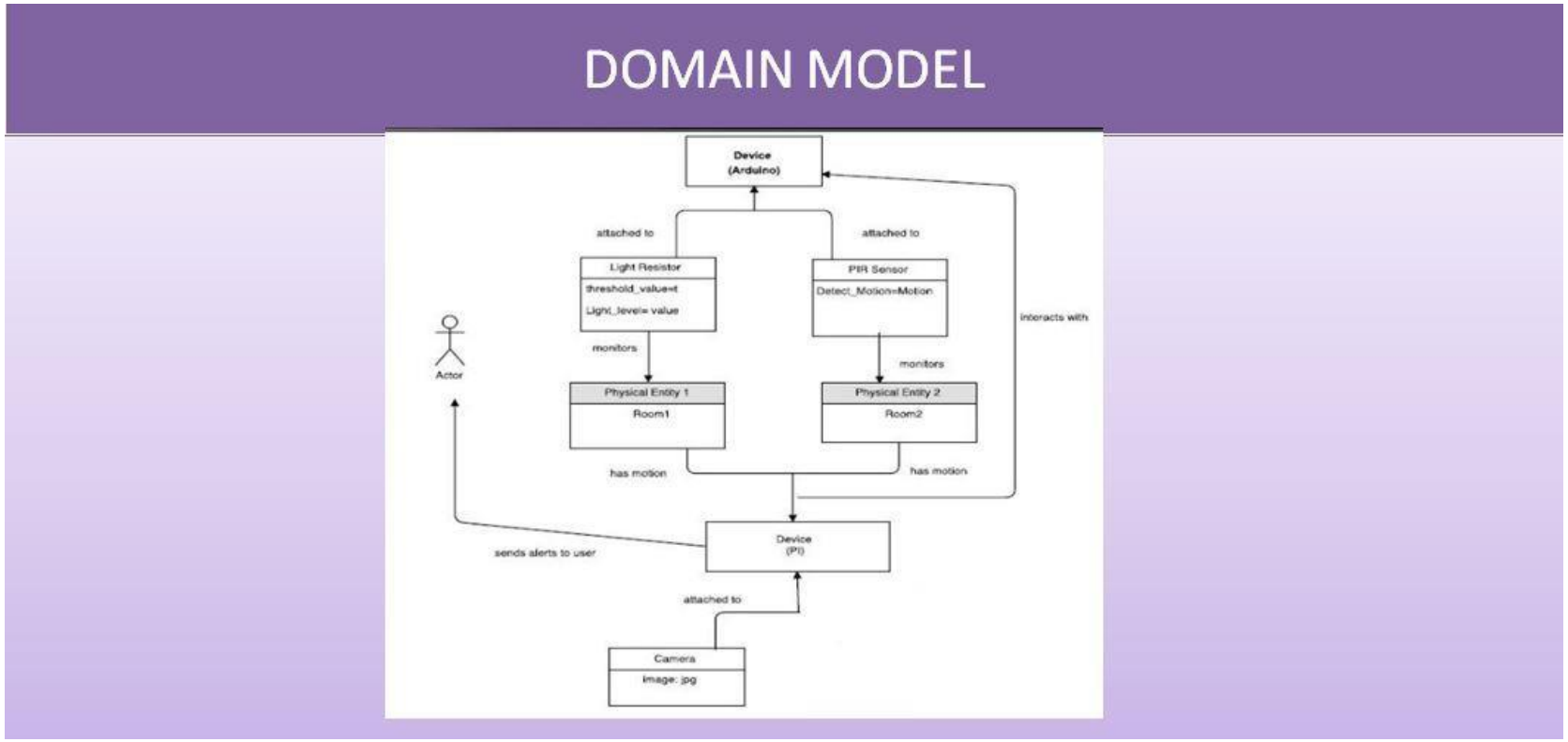


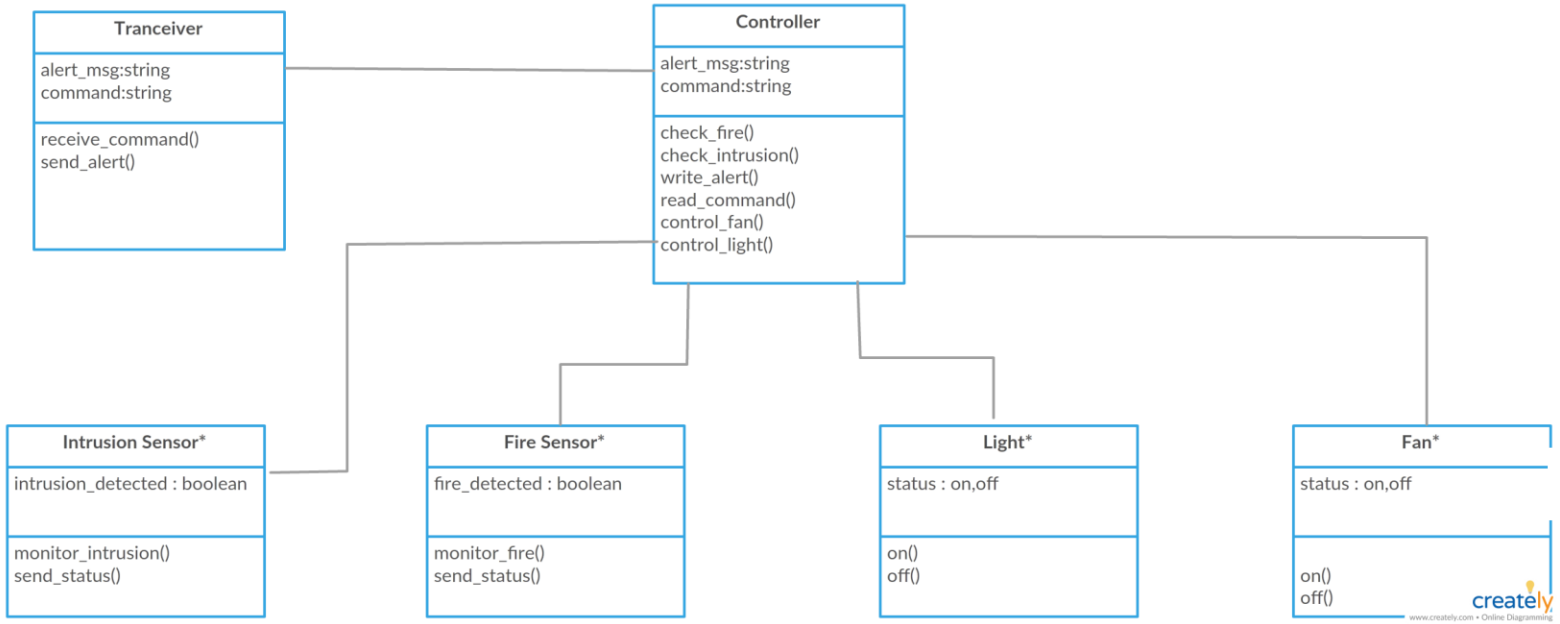
Step 3: Domain Model Specification:

The domain model specification of home intrusion detection system is as shown below:



- **Step 4: Information Model Specification**

Defines the structure of all information in the IOT system.

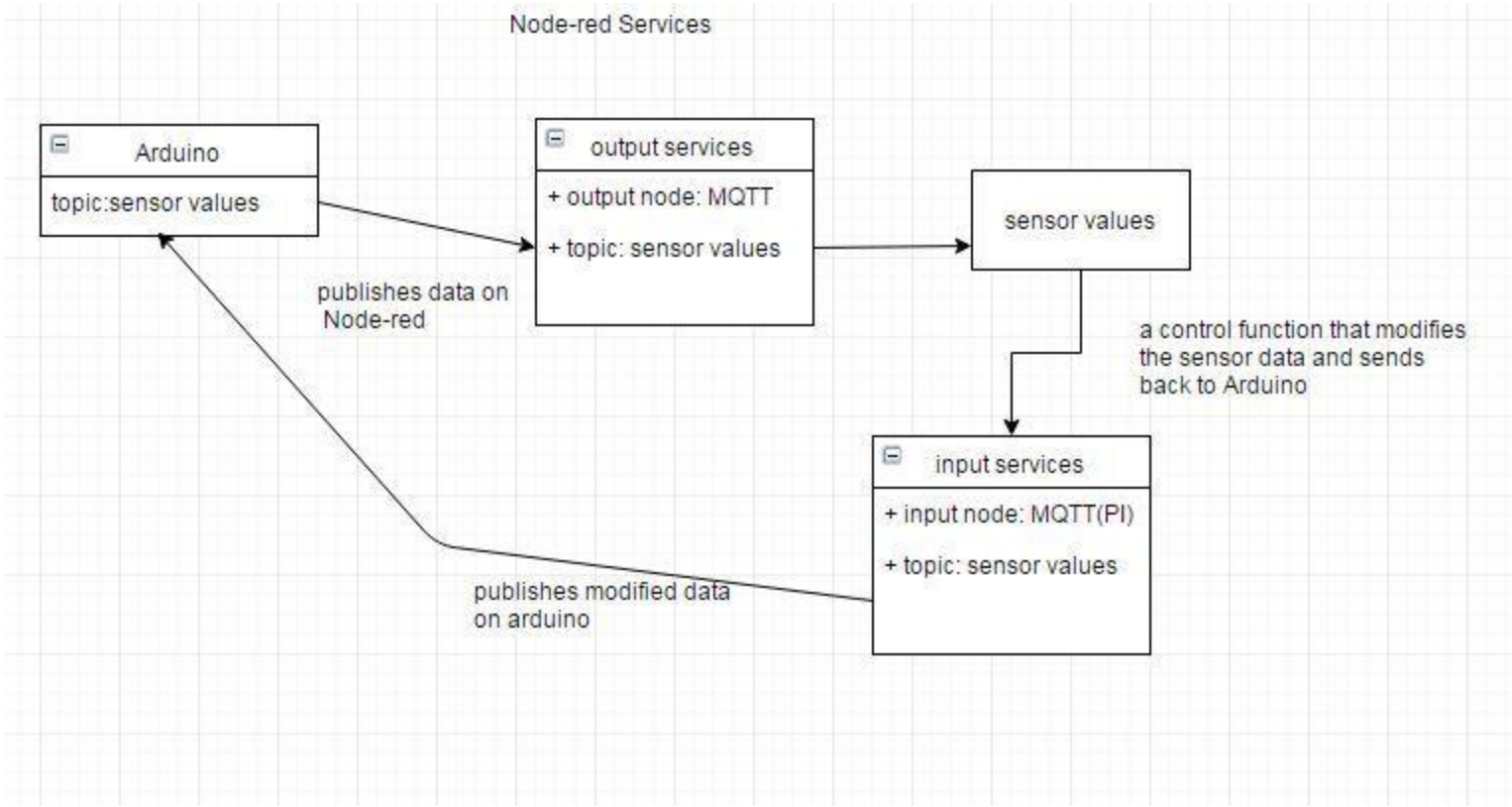


- **Step 5: Service Specifications:**

- Service specifications defines the services in the IOT system, service types, service inputs/output, service endpoints, service schedules, service productions and service effects.

- In my home-intrusion detection system, I am using node-red which provides a browser-based UI for creating flows of events and deploying them to its light-weight runtime. With built in node.js, it can be run at the edge of the network or in the cloud. The node package manager (npm) ecosystem can be used to easily extend the palette of nodes available,***enabling connections to new devices and services.***

Node-RED define flows where either incoming sensor data from 'things' is handled, e.g. stored in databases, or where commands are sent to devices. The service specifications of my home intrusion detection detection system are as shown in the below diagram:



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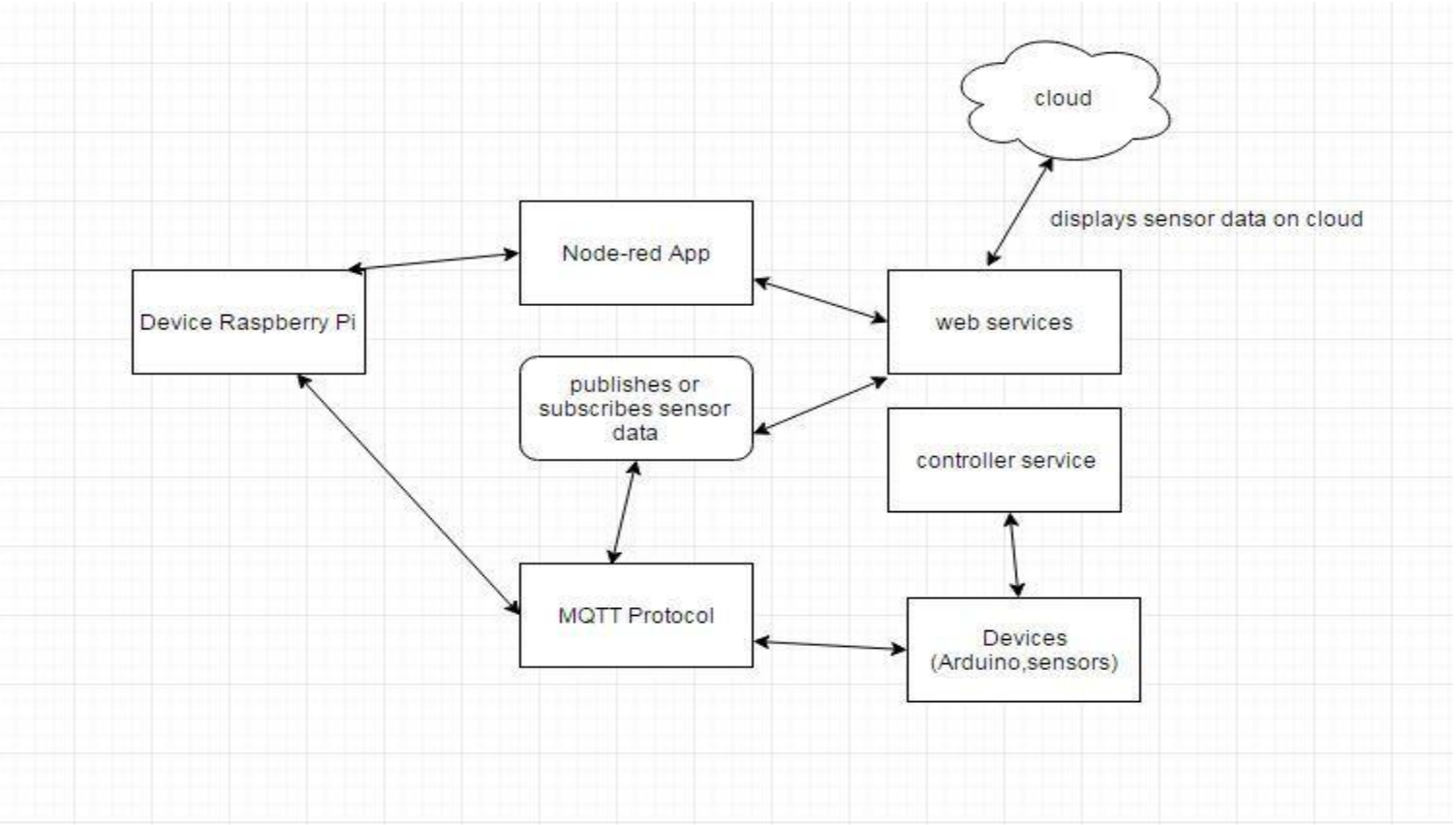
Block diagram for service specifications for my system:



Step 6: IOT Level Specification:

- I am going to implement my IOT system that is "**Home intrusion detection system**" in***level 5***. The IOT level 5 system has multiple nodes and one coordinator node. Coordinator node collects the data from the end nodes and sends to the cloud. In my system for "Home Intrusion Detection"
- The ***end node*** is "***Arduino***" equipped with PIR and light dependent resistor.
- The ***coordinator node*** is "***Raspberry Pi***" collects the data from arduino and sends it to the cloud. The analysis is done locally in raspberry pi.
- The deployment design of my home intrusion detection Level-5 system is as shown below:

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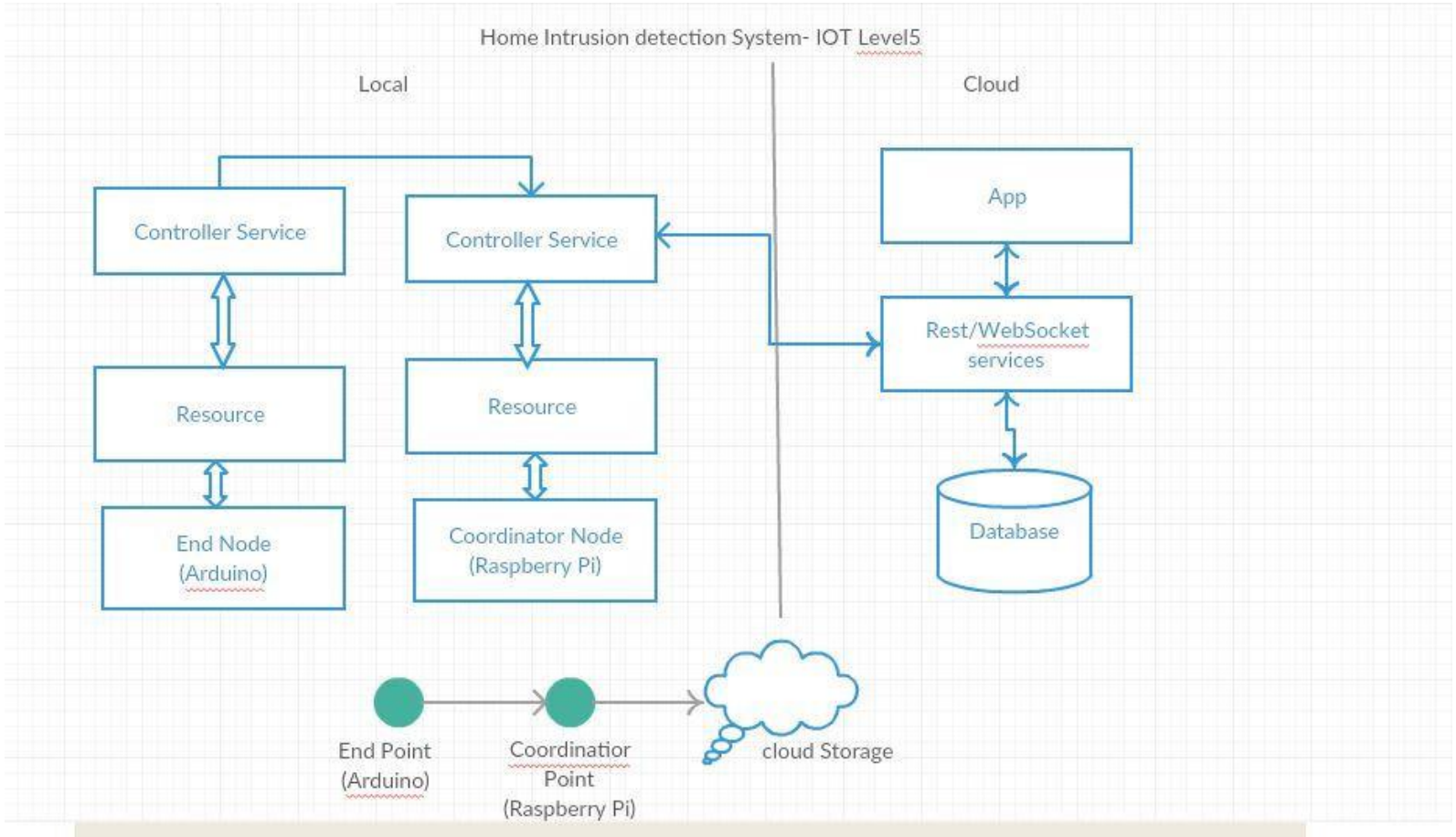
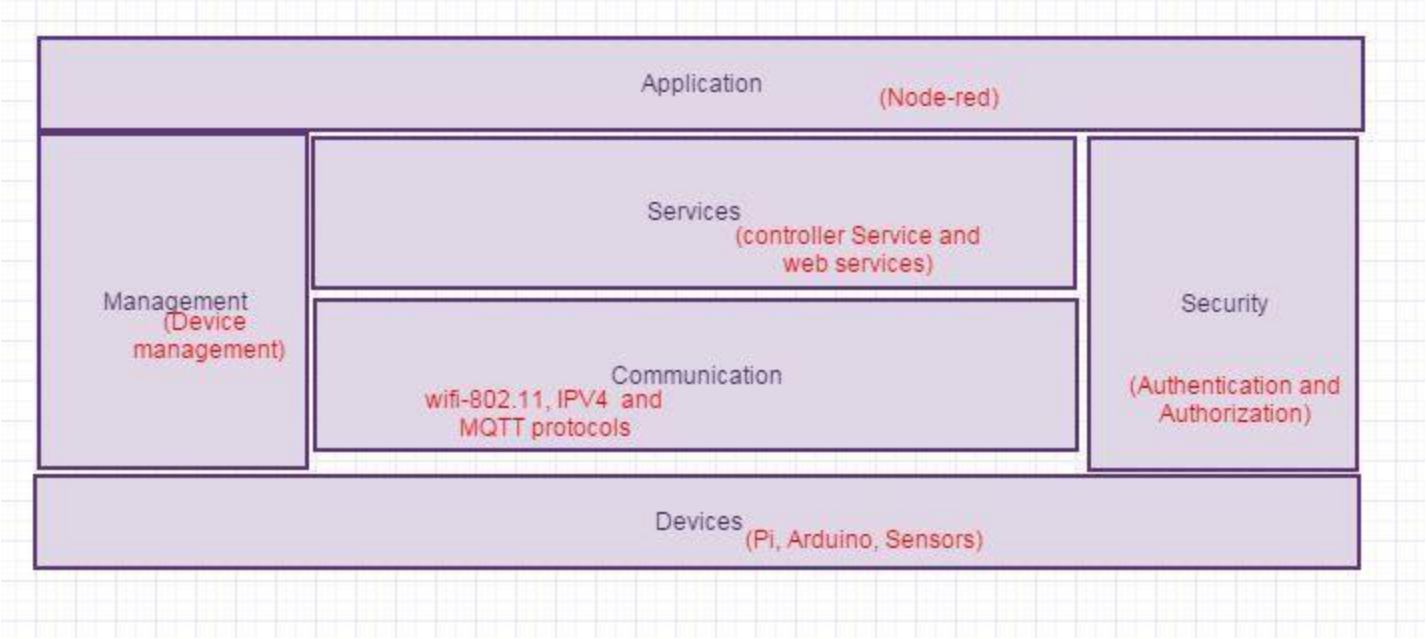


- In the above figure we can observe that from our end node Arduino, the data is sent to Raspberry Pi via MQTT. click here for a sample example to see how the data is published from Arduino to Pi. The local analysis is done on the coordinator node which is Pi in my case and the data is sent to cloud via Rest/web socket services.

- **Step 7: Functional View Specification:**

- The IOT Functional Model identifies groups of functionalities, of which most are grounded in key concepts of the IoT Domain Model. The functional view defines the functions of the IOT systems grouped into various functional groups(FGs). A number of these Functionality Groups (FG) build on each other, following the relations identified in the IoT Domain Model. The Functionality Groups provide the functionalities for interacting with the instances of these concepts or managing the information related to the concepts, e.g. information about Virtual Entities or descriptions of IoT Services. The functionalities of the FGs that manage information use the IoT Information Model as the basis for structuring their information.

The functional groups involved in an functional view are as shown in below figure:



- The detail explanation of the functional groups in the above figure is as follows:
- **Devices:** In my "home intrusion detection system" the computing devices I am going to use are ***Raspberry Pi and Arduino***. And the sensors that I am going to use to implement my system are ***PIR motion sensor, Laser pointer and the light dependent resistor***.
- **Communication:** The communication block handles the communication for the IOT system. The communication protocols allow devices to exchange data over network.I am going to use following protocols to develop my system:

- ***802.11 wifi*** protocol to determine how the data is physically sent over the networks physical layer.
- ***IPV4 protocol*** to transmit the IP datagrams from the source network to the destination network.
- ***MQTT*** a light weight messaging protocol to publish data to the applications.
- **Services:** The service functional group includes various services involved in the IoT system such as services for device monitoring, device control services and data publishing services. In my system I am going to use native service called the controller service and the web services.

- **Application:** The application functional group provides an interface to the users to control and monitor various aspects of the IOT system. I am going to use ***node-red***application to control the sensor values.

- **Security:** To ensure security for my node-red web application, I am going to use the IP address that was generated when my Pi is connected to the network . The IP address is unique and generates a new IP when a new connection is established to the Pi

- **Step 8: Operational view Specification:**

- Operation view is very important to address how actual system can be realized by selecting technologies and making them communicate and operate in a comprehensive way. The operational view specifications for home intrusion detection system are as follows:

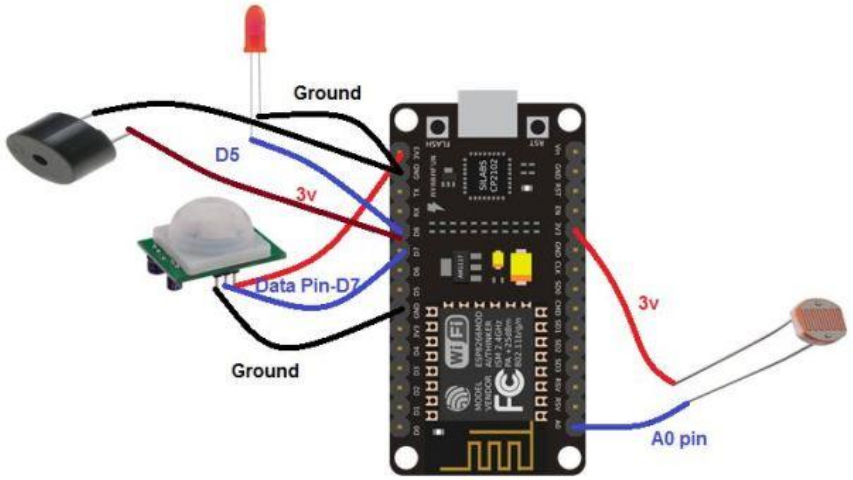
- **Devices:** The computing devices I am going to use are ***Raspberry Pi and Arduino***. And the sensors that I am going to use are ***PIR motion sensor, Laser pointer and the light dependent resistor***.

- **Communication Protocols:** Link layer 802.11, network layer-IPV4, application layer MQTT. I have mentioned all these protocols in the above figure.

- **Services:** Controller service that is hosted on my device runs as a native service.
- **Application:** Node-red web application.
- **Security:** Authentication and authorization.
- **Management:** Raspberry Pi device management.
- The mapping of operational view and functional view specifications are shown in the above figure in the functional view block where I have mentioned the operations in red.

- **Step 9: Device and Component Integration**:

- In this step we have to integrate the devices and components.The devices and components used in my home intrusion detection system are raspberry Pi, arduino, PIR sensor, laser pointer, light dependent resistor,web cam and a buzzer. The schematic diagram of my home intrusion detection system is as shown in the below figure:



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Step 10 : Application Development: